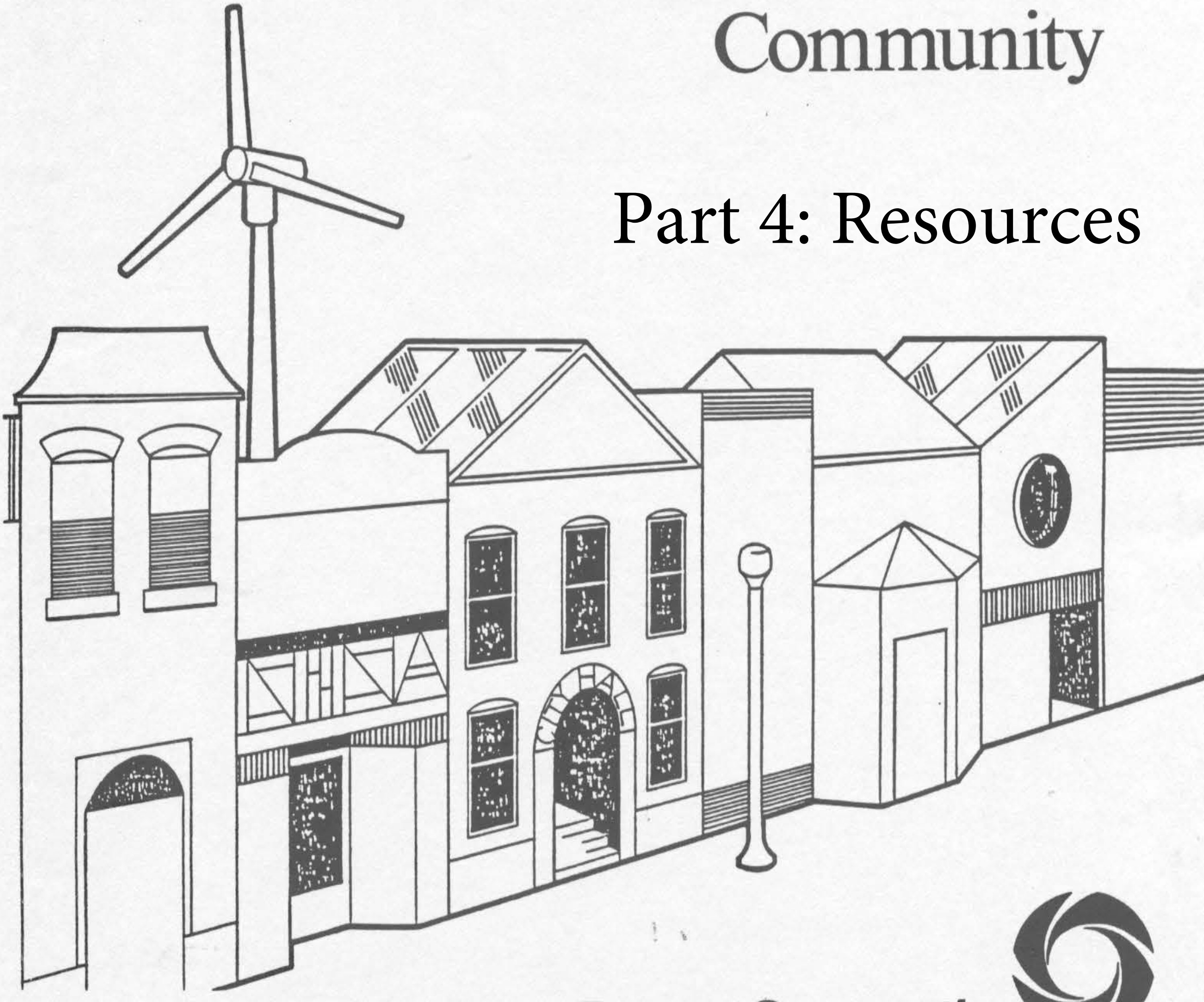
Planning the Energy Efficient Community

Part 4: Resources



Northern Energy Corporation

This guidebook was created under the direction of Gerard Ridzon, editor, and Campbell Edlund, assistant editor. Chapter authors included Campbell Edlund, William Harral, Charles Vidich, Roberta Walsh and Dr. Allen White. Special thanks also go to Louise Sutherland and LaVerne Taylor.

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PASSIVE SOLAR

Technology

Passive solar is, essentially, energy-conscious building design. Through this kind of design, a building can take maximum advantage of the natural environment to reduce its demand for heating, cooling and lighting energy.

Heating loads can be reduced by buffering a building from cold winter winds and siting and designing the building to maximize the collection of solar energy. Given an energy-conservative building and quality windows, orienting the building's major wall to the south and increasing that wall's window area can reduce heating loads 20-30 percent and lighting loads up to 100%, depending on the building. As glass area is increased to achieve reductions of 40-50 percent and more, the storage and distribution of heat and the prevention of nighttime heat loss through the glass become important issues.

Passive solar systems include direct gain systems which trap solar energy in the living space; indirect gain systems which trap and store solar energy in heat storage materials (e.g., concrete, water) before reradiating the heat to the occupied space; and finally, isolated gain systems which trap and store solar energy in a secondary sunspace (e.g., a solarium or greenhouse) and transfer heat to the living space in a controlled manner.

The first and simplest approach to passive solar heating is the concept of direct gain. In this approach, there is an expanse of south-facing glass and enough thermal mass, strategically located in a space, for heat absorption and storage. South-facing glass (the collector) is exposed to the maximum amount

of solar energy in winter, and minimum amount in summer. When the space is used as a solar collector, it must also contain a method for absorbing and storing enough daytime heat for cold winter nights, so the floor and/or walls must be constructed of materials capable of storing heat, such as brick, concrete, tile or slate. In other words, with the direct gain approach the space becomes a live-in solar collector, heat storage, and distribution system all in one. Direct gain systems use every bit of energy that passes through the glazing--direct or diffuse. Because of this, they not only work well in sunny climates, but also in cloudy climates with great amounts of diffuse solar energy, where active systems can hardly perform as effectively.

Today, the two most common materials used for heat storage are masonry and water. Masonry thermal storage materials include concrete, concrete block, brick, stone and adobe, either individually or in various combinations. Typically, at least one-half to two-thirds of the total surface area in a space is constructed of thick masonry. This implies that the interior be largely constructed of masonry to ensure that there is enough surface area of exposed mass for adequate heat absorption and storage. Water storage, on the other hand, is usually contained in only one wall of a space. The water wall is located in the space in such a way that direct sunlight strikes it for most of the day. Materials commonly used to construct the wall are plastic or metal containers. During the daytime, the mass is charged with heat so that at night when outdoor and space temperatures begin to drop, this heat is returned to the space.

Another approach to passive solar heating is the concept of indirect gain, where sunlight first strikes a thermal mass which is located between the sun and the space. The sunlight absorbed by the mass is converted to thermal energy (heat) and then transferred into the living space.

There are basically two types of indirect gain systems: thermal storage walls, or Trombe walls, and roof ponds.

The requirements for a thermal storage wall system are south-facing glass areas (or transparent plastic) for maximum winter solar gain and a thermal mass, located 4 inches or more directly behind the glass, which serves for heat storage and distribution. Heated air rises through this air space and is

channeled into the living spaces through openings in the top of the wall. Openings at the bottom of the wall permit cooler air to be pulled in, heated and distributed again to the living spaces. This is known as the "thermosiphoning effect."

In a roof pond system, the thermal mass is located on the roof of the building. In this case water ponds, enclosed in thin plastic bags, are supported by a roof (usually a metal deck) that also serves as the ceiling of the room below. In winter, the ponds are exposed to sunlight during the day and then covered with insulating panels at night. Heat collected by the ponds is mostly radiated from the ceiling directly to the space below. In summer the panel positions are reversed, covering the ponds during the day to protect them from the sun and heat and removing them at night to allow the ponds to be cooled by natural convection and by radiation to the cool night sky. After being cooled at night, the ponds are then ready to absorb heat from the space below the following day.

A third approach to passive solar heating is the concept of isolated gain. In principle, solar collection and thermal storage are isolated from the living spaces. This relationship allows the system to function independently of the building, with heat drawn from the system only when needed. The most common application of this concept is the natural convective loop. The major components of this system include a flat plate collector and heat storage tank. Two types of heat transfer and storage mediums are used: water, and air with rock storage. As the water or air in a collector is heated by sunlight, it rises and enters the top of the storage tank, while simultaneously pulling cooler water or air from the bottom of the tank into the collector. This natural convection current continues as long as the sun is shining.

Passive solar can be applied to existing buildings as well as new construction. There is a significant market developing in the Northeast for retrofit solar greenhouses and sunspaces. The sunspaces can be easily attached to the south side of homes or small retail and office buildings even if the homes themselves do not face south. Depending on use patterns, an 8' x 12' sunspace can contribute 15-20 percent of a typical home's heating load, even with tough Northeast winters.

Cooling loads can be reduced by designing natural ventilation and nighttime radiational cooling systems into the building. These systems are especially important in the Southwest where cooling loads are high and clear skies usually prevail. It is much more difficult to apply passive heating and cooling to high-rise commercial buildings (other than glazing control) but consideration of natural lighting can reduce lighting and cooling energy substantially.

Passive solar is a mix of system designs, components and building techniques. Simple passive systems and techniques, such as the siting of buildings and window design and placement, are ready for widespread use in the conventional building industry today. Passive technologies, such as envelope homes and homes with high storage mass, need more development before they become an important factor in rapid commercialization. The average builder will have to see considerable practical experience with these approaches before he undertakes the risks involved in their adoption.

Economics

The incremental building costs associated with passive solar range near zero for certain siting and window-placement techniques, to very high for certain, custom-designed systems. It is reasonable to expect a high level of performance (30-50 percent of the building heating load supplied by solar) from a system adding five percent to the cost of building construction. Highest cost items in the system are normally the heat storage element and movable night insulation.

Some excellent passive solar homes in the Northeast have annual heating bills close to \$100 in areas where equivalent homes cost over \$1,000 to heat. Considering simple payback of the initial system cost via energy savings, these systems will pay for themselves in less than five years. More sophisticated financial analyses which consider the escalating cost of fuel will, of course, show even more favorable results. It should be noted, however, that prediction of a building's passive solar performance is at best uncertain and that real performance of buildings is strongly influenced by the use patterns of its occupants. In the case of commercial buildings, solar

energy in combination with heat recovery will play an important role in energy conservation. The excess heat generated by lights, equipment and people during the day as well as solar energy collected can be stored until evening and used to heat commercial buildings overnight.

Another factor which will increasingly favor passive construction over the next few years will be improved resale values for homes with low heating costs and an increased rental demand for energy-efficient office space. A reduced monthly energy payment directly increases a business' profit potential or a homeowner's ability to make mortgage payments, and banks are beginning to consider this in their lending practices.

Marketplace

It is difficult to assess current activity in passive solar since so much of it is design and construction practice using conventional building materials. However, several trends are evident. Many leading solar builders and architects have designed and constructed buildings which are clearly passive solar. These homes and low-rise commercial buildings help to advance the technology while sparking public interest through media reporting. There are several thousand documented passive solar homes and several hundred identifiable passive solar commercial buildings in existence.

There is a growing passive solar industry and its recently formed Passive Solar Industries Council is beginning to have an impact on commercialization. Many important building industries such as glass manufacturing, window manufacturing and building supply are now incorporating passive solar concepts into the merchandising of their products.

Of course, passive solar commercialization is subject to forces within the housing industry. The current high mortgage interest rates are causing reductions in housing starts, but there is substantial activity in the home improvement sector. Most builders expect housing starts to recover to 1.5 - 2.0 million next year, and it is possible that five percent of the housing starts in 1985 will be specifically marketed as passive solar homes.

Barriers and Incentives

Except for the very unusual passive solar concepts, passive solar should not be impeded significantly by building codes, nor should solar access be a problem except in areas of high density. Land use regulations could have an impact, however, in that they might require a builder/developer to endure additional delays during the approval cycle for housing sited for passive solar or discourage innovative designs requiring non-traditional setbacks and orientations.

Developing tax incentives for passive solar is difficult since these systems are integrated into the structure of a building and performance is difficult to predict. The current incentives are inadequate for most direct-gain and isolated-gain systems. The IRS regulations are typically written to accept only those system elements that are clearly not part of the conventional building system; for example, heat storage products, controls and glazing/absorber assemblies. Windows and foundation floors which serve as heat storage do not qualify, although some system elements may qualify for conservation tax credits.

Outlook

Passive solar has a bright future in this country. Exciting new concepts, designs and products are under development which will make our buildings far more energy-efficient and thus more marketable.

5 Traditional Energy Efficient Home Designs

"These traditional homes using basic passive solar techniques and higher levels of thermal protection should attract new market interest."

Ralph J. Johnson, President
NAHB Research Foundation, Inc.

The "Energy House"

The designs for each "energy house" described in this publication are variations of a conventionally built house. By using more insulation than that featured in standard homes, by rearranging floor plans and relocating glazing, the builder offers a conventionally styled home with significant energy savings.

The conventional home from which the "energy house" was developed is insulated to R-11 in the walls, R-19 in the ceilings, has single glazed windows with storm sash and an uninsulated basement. To take advantage of passive solar gain, the redesigned energy house has been reoriented to have the rear side of the house face south to provide for better solar collection and better heat distribution within the house. Bedrooms were moved to the south side of the house; bathrooms and storage areas were relocated to the north side and some partitions were removed.

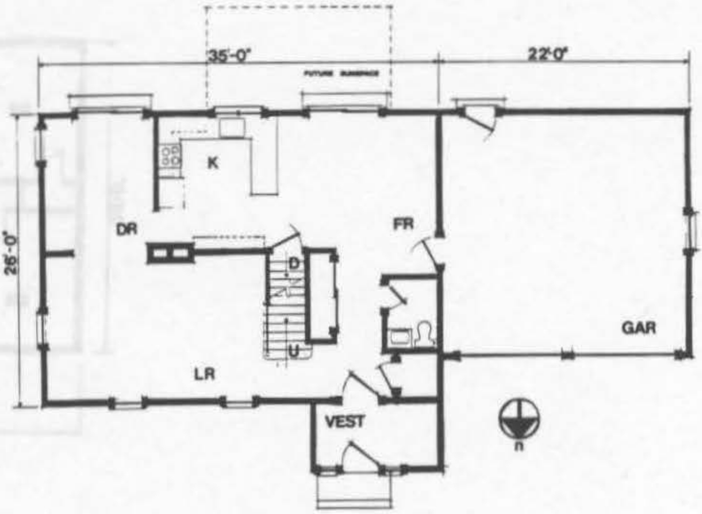
The energy conservation measures of the "energy house," a marked improvement over those of the conventional house, include well-insulated walls, roof and basement. The walls are constructed with 2" x 6" studs, 24 inches on center, so that the cavity will accommodate R-19 batt insulation. The roof is typical rafter and joist construction that uses R-38 batts as insulation. The walls of the unheated basement are framed with 2" x 3" studs recessed from the wall to allow for placement of R-11 batts. Six-mil vapor barriers are used per NAHB Research Foundation, Inc. recommendations. The infiltration rate of the energy house is assumed to be .6 air changes per hour.

Glazing area on the south side has been increased to optimize solar collection and heating by natural means and north glazing has been decreased slightly. The north, east and west facing windows are triple glazed. The south windows are double glazed and feature moveable insulation (R-9) for nighttime use. The exterior doors are also insulated.

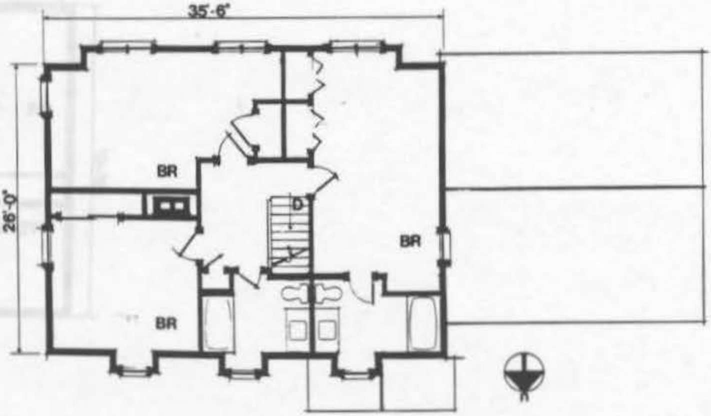
The chimney, centrally located to reduce heat loss, has two flues so that the homeowner has the option of installing a wood stove. The furnace uses outside air for combustion to improve efficiency. To lower energy needs for hot water, the hot water tank is wrapped with insulation and water saving shower heads have been installed to reduce hot water consumption.

The estimated energy savings of the following five house designs are derived by comparing energy use of the conventional houses with that of the "energy houses."

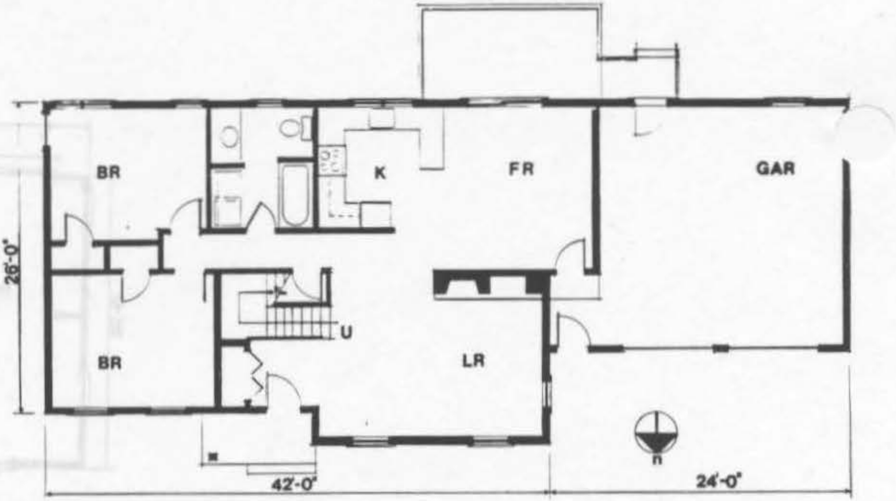
Further energy savings could be achieved in any of these houses with the addition of such options as a solar sunspace, solar water heater, heat pump and energy efficient appliances.



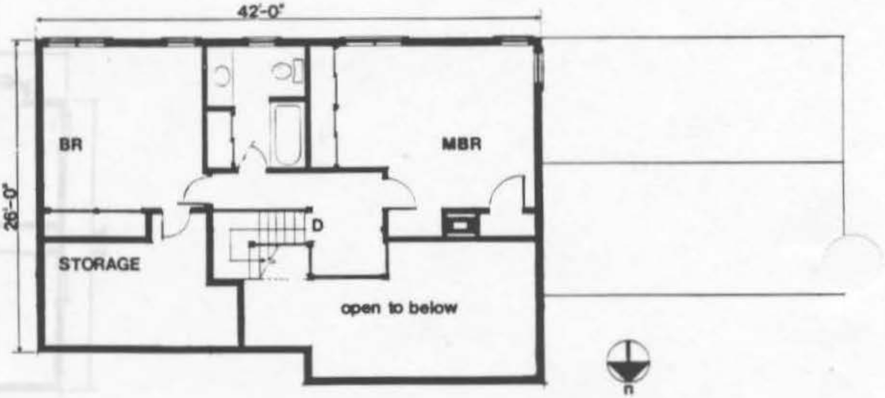
FIRST FLOOR PLAN



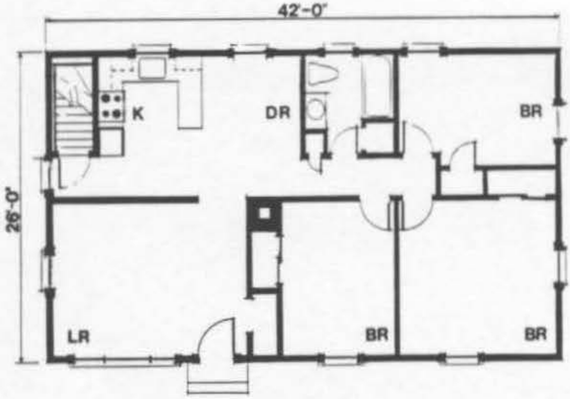
SECOND FLOOR PLAN



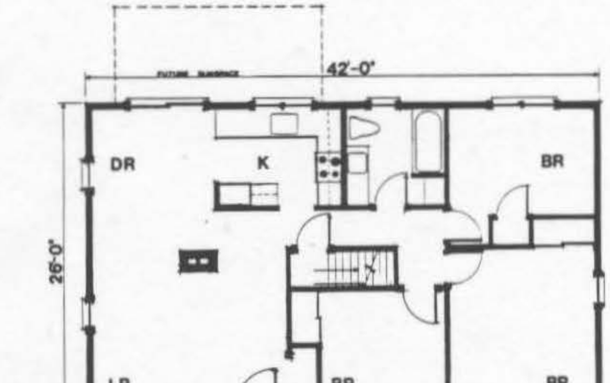
LOWER LEVEL PLAN



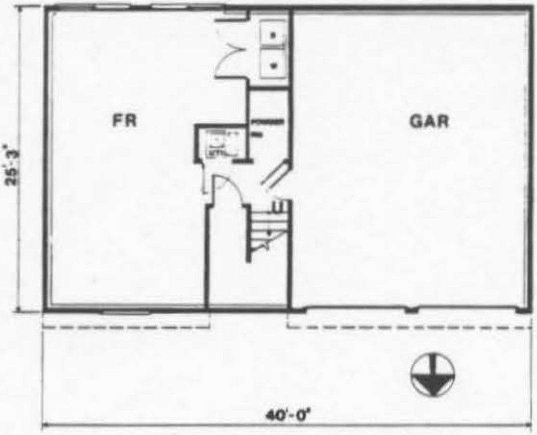
UPPER LEVEL PLAN



CONVENTIONAL PLAN



"ENERGY HOUSE" PLAN



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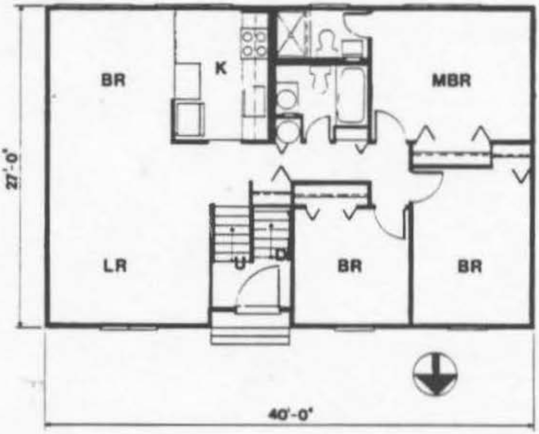

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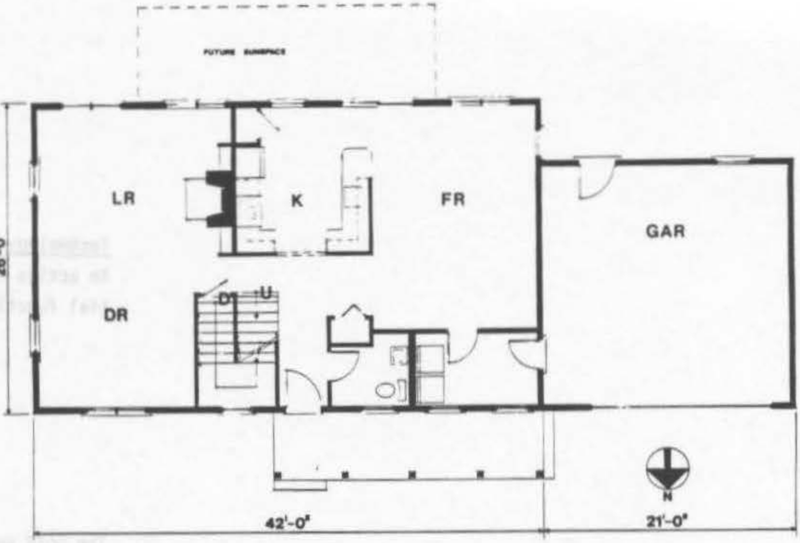


FIRST FLOOR PLAN

SECOND FLOOR PLAN

OVERVIEW

ACTIVE SOLAR

Technology

An active system consists of four main parts, each with an essential function:

Collector--to capture the solar heat.

Transport system--filled with a transfer medium (either liquid or air) which circulates the heat from collector to storage by means of a pump or blower.

Thermal storage unit--to retain heat for use at night, or on cloudy days.

Auxiliary heat source--a conventional heating system to be used for backup.

The most common types of collectors are flat-plate, evacuated tube and concentrating. The flat-plate collector is designed to deliver energy at temperatures up to 150° F above ambient temperatures. Since hot water is normally stored at 140° F, and hydronic space heating requires temperatures no higher than 180° F, flat-plate collectors are most effective for these purposes. The flat-plate collector, the workhorse of all solar collectors, collects direct, diffuse and reflected radiation, and does not require direct orientation to the sun at all times of the day. If properly designed and installed, it requries minimal maintenance and has a life expectancy of 20 to 25 years.

The evacuated tube collector resembles a fluorescent light tube, with a liquid-filled cylinder inside it. A vacuum surrounding the liquid tube insulates against heat loss, and protects against deterioration of the absorber coating. The evacuated tube is more effective for high temperature applications, such as industrial process heat.

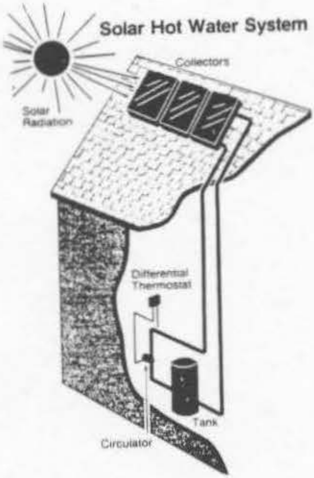
Concentrating collectors, also reffered to as focusing or tracking collectors, all work on the same principle. The sun's radiation is reflected off one or more mirrors concentrating that radiation on a small absorber area. There are several types of concentrating collectors, most requiring mechanical devices to shift collector position and track the sun as it crosses the sky. High cost and

complexity discourage concentrating collectors' use in most residential applications, however, they show promise for industrial use.

Economics

Approximately 90 percent of the solar systems currenty in place in the Northeast are used for domestic hot water heating. The average cost of a solar water heating system installed professionally in the Northeast ranges from \$3000 to \$4000. Generally, costs of \$42 to \$62 per square foot of collector area can be expected for residential solar hot water systems. The customization and modifications required for most commercial and industrial applications tends to make cost generalizations difficult.

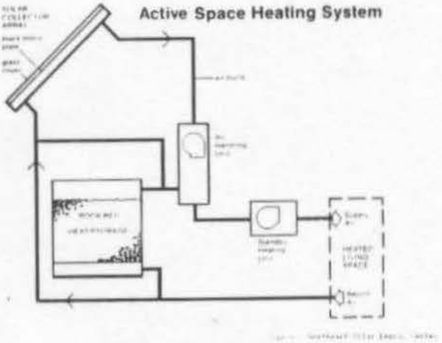
FIGURE I



Water heating can represent as much as 20 to 30 percent of a homeowners' energy bill and even greater amounts for business and industries which use hot water in product related processes. In the Northeast, a properly installed solar water heating system will provide 40 to 60 percent of a building or businesses' water heating demand.

Residential space heating, though not cost effective in retrofit applications like solar water heating, is competitive with oil and electricity in new construction. A solar space heating system installed in a home during its construction costs between $6000 and $20,000, depending on the buildings size and heat loss. Higher costs can probably be expected in most commercial and industrial applications. Properly installed, a solar space heating system can provide a building eith 50 to 70 percent of its heating demand anywhere in the United States. The 40 percent federal tax credit given on residential solar, makes those applications especially cost effective. The costs of solar for commercial and industrial applications is reduced by a 15 percent investment tax credit on solar and an additional 10 percent credit if the solar aids in a product related process.

FIGURE II



Marketplace

Approximately 100,000 active solar systems are currently in place in the United States with roughly 12,000 of these systems located in the Northeast. At this time, over 150 solar collector manufacturers are listed as doing business. According to a U.S. Department of Energy study, the residential market sector presently accounts for 83 percent of solar collector end-use application with the commercial sector next with 12 percent. In the Northeast, over 1100 businesses listed themselves as solar installers in 1980.

Barriers and Incentives

The escalating prices of conventional fuels (oil and electricity) provides a ready-made incentive to consumers to buy solar. The attractiveness of solar also becomes evident on the community and commercial levels as these energy cost increases cut into the budgets of local governments and the profit margins of businesses. Another incentive is the 40 percent federal tax credit for residential solar applications and the 15 percent (and possibly 25 percent) investment tax credit available to businesses and industries going solar. Many states also have financial incentives. (See Federal and State Incentives in Resources Section.) In addition, a solar system adds to the resale value of property.

Despite the fact that a residential solar water heating system can pay back its initial cost in four to five years in energy savings, the initial investment is usually a barrier to consumers, particularly in this time of high lending rates. The federal tax credit does not alleviate this problem, as it is a rebate, not an up-front subsidy. Although not a problem in most cases, solar access questions and legal barriers can pose a potential barrier to a solar installation.

Outlook

In the Northeast 60 to 85 percent of the homeowners depend on #2 heating oil for space and water heating with businesses and industries using even greater amounts. The escalating price of oil, as well as electricity, increases the market potential for active solar systems. In fact, the potential exists to double the number of systems in place in the United States each year through 1985--a forecast that over 700,000 active systems will be in place at the end of 1985.

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OVERVIEW

WIND

Technology

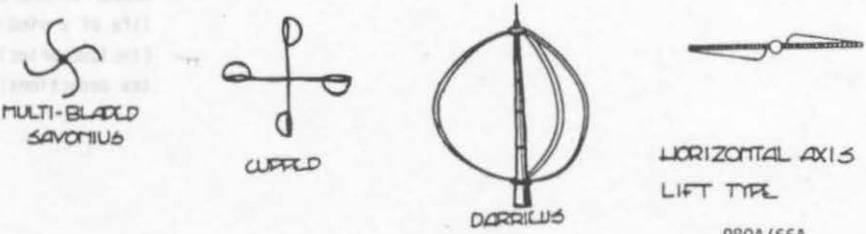
Wind energy systems convert the kinetic energy of the wind into mechanical and electrical energy. The principle application of wind energy systems is considered to be electric power. Other uses involving the direct production of mechanical energy are also possible.

Present-day wind machines are more than twice as efficient as the traditional windmills long used in water pumping applications. Although no scientific breakthroughs are required to make wind energy economically feasible, continued research and development will increase the reliability and cost-effectiveness of wind machines.

These modern wind machines can generally be grouped into three size classes based on power production.

- small — 0 - 100 kW
- intermediate — 100 - 1000 kW
- large — 1000 - 3000 kW

Figure 1 illustrates several types of wind machines: Savonius, cupped, Darrieus (or egg-beater) and horizontal lift-type.



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Economics

A definitive method of comparing costs of wind systems is to compare the cost of energy that they produce. This cost is most dependent on the capital cost of the machine and the activity-level of the wind site. Small machine energy costs range from \$0.30/kWh to \$0.06/kWhr, intermediate machine costs from \$0.45/kWhr to \$0.06/kWhr, and large machines from \$0.25/kWhr to \$0.03/kWhr. For comparison, typical residential rates are now \$0.06/kWhr to \$0.08/kWhr.

There are two kinds of costs to consider when assessing the economics of a wind machine: initial cost and cost of energy.

Initial cost is the total cost of all the components which comprise a wind system, including the machine itself, the tower, electrical wiring, the inverter or storage batteries (if needed), installation costs and the cost of measuring wind speed at the site. The quickest cost analysis you can make is to get a price list for a complete system of the size you need from several manufacturers. Federal tax deductions for new wind systems are also a available.

A more realistic way of determining the actual cost of wind power is to determine the cost of energy provided by a wind machine during its lifetime. The cost of energy (in cents per kWh) produced by a wind machine at your site can be very roughly estimated once you know your average annual wind speed, the cost of the wind energy conversion system which will meet your energy requirement (be sure to include all costs, including the annual maintenance) and the federal tax deductions you can realize.

Just estimate the typical power output from the wind turbine (i.e., its output at the average wind speed for your site), multiply this by 8760 (the number of hours in a year) and multiply the total by 20 years (the expected life of a wind machine). Then divide the total cost of the wind system (include principal <u>and</u> interest if you make a loan and subtract the expected tax deductions) by the total number of kWh expected to be produced by the

machine (as calculated above). When you get your total, remember that utility power costs will increase during the life of your machine, although it's probably not wise to assume a specific inflation level.

The formula presented below is a mathematical representation of the cost estimation process:

$$\frac{\text{(Total life cost in dollars)}}{\text{Average Power output in kilowatts} \times 8760 \text{ hours} \times 20 \text{ years}} = \text{Cost of energy } (\text{¢ per kWh})$$

Marketplace

The number of installed wind systems is difficult to estimate. In the Northeast Region, approximately 400 wind machines exist, while 5,000 are installed nationwide. Most of those 5,000 machines are the familiar farm style water pumpers, common in the western U.S.

There are 14 manufacturers of wind systems in the Northeast with more than 50 dealers and distributors. Nationally, there are 35 manufacturers of wind equipment.

The total wind energy resource in the United States (including off-shore) is very large, but much of it will probably not be used because the average wind velocities will be too low for cost-effective operation. However, it is estimated that up to 2-3 quads of fossil fuels could be displaced by the year 2000 by wind systems located at favorable sites in the nation. Thus, it is extremely important to locate and map areas of greatest wind velocity if this resource is to be fully exploited.

In the Northeast region alone, 160,000 wind turbines of various sizes might be used to generate power in order to reach the year 2000 goals. Popular applications will consist of generating electricity for farm, residential, industrial or utility use and generation of hot water directly by

mechanical stirring for use by farms or residences. Where power costs are high, or where mechanical or electrical power is needed in a remote location, and wind resources are plentiful, installing a wind machine may offer definite economic and operational rewards. The steps necessary in the decision-making process are listed below:

Steps for Determining the Practicality of a Wind System

1. Evaluate potential legal and environmental problems
2. Evaluate your energy requirements
3. Evaluate the wind resource at your proposed location
4. Evaluate the application
5. Select system and components
6. Evaluate the cost of the system
7. Re-evaluate energy requirements and legal and environmental impacts
8. Evaluate alternatives in buying, installing, and owning a wind system

Increased federal and state tax incentives plus a new regulation requiring utilities to buy electricity from wind turbine owners combine to create many promising near term markets for wind turbines.

Barriers and Incentives

No major legal barriers exist. Local zoning by-law amendments, if necessary, can slow the installation process, however. Financial incentives exist at the federal level and in many states. The new Public Utility Regulatory Policy Act (PURPA) regulations for wind turbines allow the owner to be reimbursed by the utility company for electricity fed back into the utility grid.

Environmental effects from wind turbines are minimal. The noise made by wind turbine blades is in most cases not heard beyond the immediate area of the machine. TV interference can be a site specific concern for utility scale wind turbines. Public acceptance can also be a problem.

Outlook

Wind energy appears to have a bright future. Currently envisioned cost reductions of reliable wind turbines should ensure rapid growth of the wind industry. In many U.S. markets wind energy has the lowest near term projected cost of energy of any solar electric option.

Private wind farms, or privately owned clusters of wind machines with generating capacity only large enough to supply several residential or small commercial consumers, represent one of the future market possibility for wind energy. In fact, in the future, the utility and private wind farm markets in the United States and abroad will probably predominate.

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NORTHEAST REGION ANNUAL AVERAGE WIND POWER

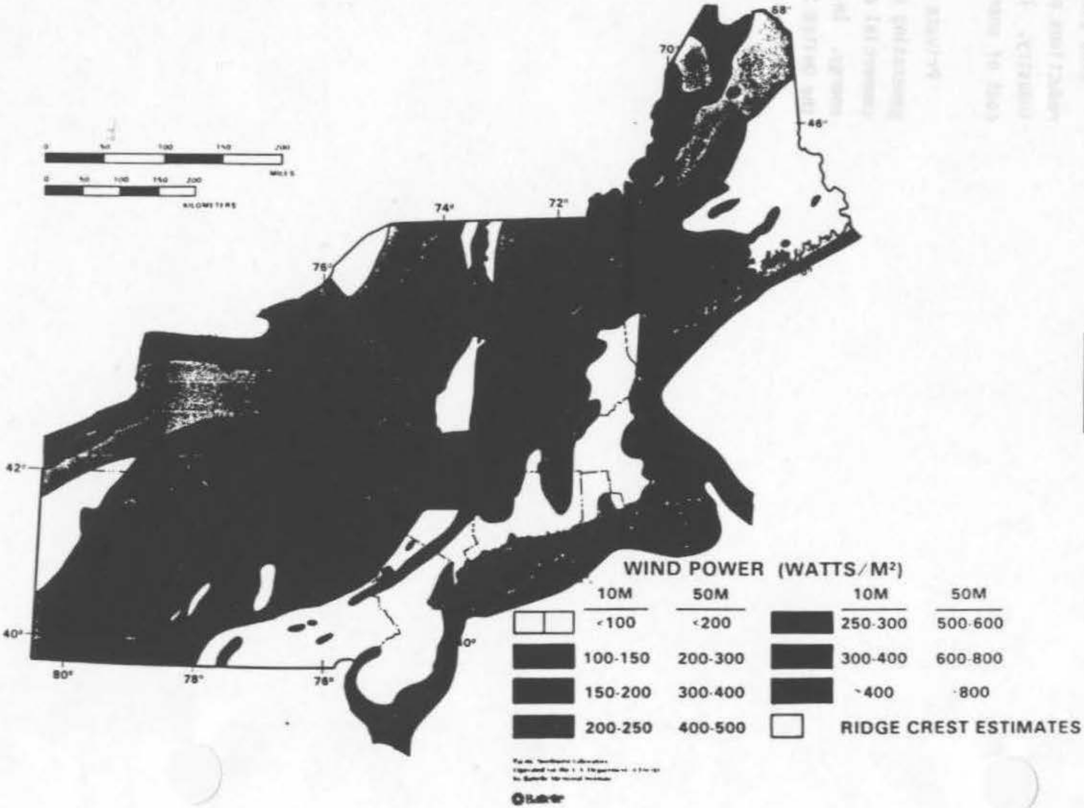

FIGURE 2

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OVERVIEW

BIOMASS

Technology

Public Buildings:

It is already feasible to use wood energy for many buildings' space heat and hot water requirements. Technological advances and equipment development now nearing completion will soon make it practicle to substitue wood in nearly all circumstances. Stoves and furnaces burning chunk wood may always be applicable for unique situations in small buildings or spaces requiring supplemental heat. Industrial wood boiler systems have long proven dependable and practical when large energy needs occurred where sufficient space was available for wood chips handling and storage. Boilers using wood chips as fuel are now also available in the energy mid-range between chunk wood furnaces and industrial boilers.

The most significant advances in wood energy technology are in the areas of convenience and automation. Coincidently, and perhaps equally as important, these advances have increased combustion efficiency and lowered air pollution emissions. Three examples deserve special attention:

(1) The "Hill furnace" burns chunk wood under optimum combustion conditions. Heat is stored as hot water until needed. Firing need be done only every 1-3 days, depending on weather and sizing. Presently available for residential use, parallel units or larger systems would be suitable for many institutional needs.

(2) Auger fed or stoker systems, similar to those used to burn coal, can operate automatically on wood chips, densified wood pellets or cubes, or powdered wood. These require minimal supervision and maintenance.

(3) Gasifiers reduce densified wood or chips into a number of combustible gases in an oxygen starved environment. The gases are then introduced into a combustion chamber where a spark and oxygen are added. The biggest advantage of this system is that it can use an existing oil or gas furnace as the combustion chamber, substituting the gasifier for the oil or gas delivery system. Such a retrofit is relatively inexpensive. These systems, while commercially available, are not yet considered fully reliable.

Note should be made of the term "densified wood." This product consists of wood pulverized, dried, and then squeezed to a density about twice that of the heaviest hardwoods. The resulting product is consistent, dry, having "fluid flow" characteristics, and requiring only half the storage space per BTU as common wood. Periodic, unobtrusive delivery of densified wood the way oil is delivered today is feasible. This product is not available in all areas yet, but supplies are expanding.

Municipal Electric Generation

Wood used as a fuel in the production of electricity is common in the wood using industry. Recently Burlington, Vermont converted two 10-megawatt (MW) boilers to wood chips and, based on their successful experience, has applied for permits to build a 50 MW plant. At least two other municipalities in the United States are proceeding with similar plans. Cogeneration of electricity and process steam for industrial purposes can prove highly efficient when the proper match can be made between electric demand and industrial steam demand. Municipal electric generation in conjunction with steam production for an adjoining industrial park may have unique advantages.

Wood as a Supplement to Municipal Solid Waste

Economies of scale often prevent the use of municipal solid waste as a feasible energy source. Wood, especially wood residues containing foreign substances which make them less desirable as a fuel, can be added to MSW to better the economies of scale of an energy plant. Bark, discarded wooden pellets and crating, and building demolition materials are wood energy sources which are poor by wood standards but better than average by MSW standards.

Industrial:

Improved wood handling and combustion systems for fuelwood have enabled many industries to satisfy much of their energy needs by the burning of wood waste and residues. Those residues, which in some cases once posed a disposal problem, now replace fossil fuels in the production of space heating, industrial process heat and electrical power.

Typically, a wood system starts with a storage bin or pile for the wood residue, which is conveyed to a grinder (or "hog") that converts the supply to fuelwood of required size. The fuel is then either stored again or fed into the combustor, usually a firetube or wastetube boiler.

More than one-half of the energy requirements of the forest products industry (lumber, paper and furniture) are currently met by combustion of self-generated wood residues. State medical facilities and educational institutions located near reliable fuelwood suppliers are among recent converters to wood fired systems.

Residential:

Residential use of fuelwood has grown so rapidly in some rural regions that it is hard to spot a house without a stack of wood nearby. Improve designs for wood burning stoves and central wood burning furnaces prevent

excessive heat loss up a chimney, giving wood an economic edge over heating oil, even when purchased at higher prices.

Recent studies have established that in the fuel oil dependent Northeast, one third of all homeowners rely on fuelwood as a heat source to some degree.

The often voiced concern that growing reliance on fuelwood will deplete forest resources is unfounded. In fact, fuelwood demand presents an opportunity to improve forests that have been poorly managed. Proper harvesting of fuelwood usually amounts to the thinning of timber stands, and allows the unobstructed growth of high quality "crop" trees destined to be lumber, and faster growth of other trees suited for papermaking.

Economics

For commercial-scale installations, the cost of conversion to wood-fired system can range from a few thousand to many millions of dollars, depending on the size and complexity of the operation. Despite the costs, many converters -- particularly those having on-site wood residue production -- recoup the initial outlay through fuel savings in a very few years, and in some cases, in less than a year.

Residential fuelwood users encounter initial costs of between one hundred to a thousand dollars for a woodburning stove, and up to two thousand dollars for a wood fired furnace. In return, homeowners who cut their own wood supply can reduce fuel costs to a marginal figure (in exchange for a few weekends of cutting and splitting), while homeowners who purchase their fuel supply often cut their annual fuel bill (for wood and fossil fuels) in half.

Marketplace

Both commercial and residential fuelwood equipment are available from hundreds of manufacturers and suppliers, many of whom never fully left the business when America converted to fossil fuels, and others who entered the

market in response to the renewed interest in wood. Both groups have contributed to improved system designs. For commercial systems, the largest manufacturers tend to be located in the South, Pacific Northwest and Great Lakes Regions. Residential woodburning stove manufacturers are found in most regions of the country that are forested.

The market potential for institutional, industrial and residential users is considerable, as only a small percent of the potentially available fuelwood is currently being burned. The resource is not, however, evenly spread near otherwise potential users, since the trucking radius of fuelwood is only 50-60 miles (although it is about 200 miles for wood that has densified and pelletized). Industrial sites in the forested regions will therefore undergo numerous conversions, while other regions on the fringe or beyond large scale wood operations will see little or no fuelwood use in the near future.

Barriers and Incentives

Incentives to fuelwood development include the following:

- Wood is an indigenous and renewable resource.
- Large quantities of wood residues are available now.
- Technology is improving for pelletization, boiler systems, cogeneration and emissions control.
- Numerous installations -- small and large -- are currently operating successfully.
- Interest is growing among non-forest product institutions and facilities.
- Encouraging results from wood-coal firings.
- Tax incentives improve the economic feasibility of conversion.

The current drawbacks to fuelwood use are:

- Inadequate breakdown of wood residue availability by geographic regions
- Potentially high capital cost of conversion

- High transportation and handling costs
- Increasing competition for a versatile resource
- Environmental restraints

Outlook

Fuelwood use will continue to develop as one of the country's most productive renewable resources; the technology already exists that makes fuelwood economically viable, and established marketing and system delivery firms are well-established.

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OVERVIEW

SMALL-SCALE HYDROELECTRIC

Technology

Water power has been used as an energy source since the colonial era, and still produces between 13 and 15 percent of the nation's total supply of electric energy. This annual total generation of approximately 64,000 megawatts makes hydropower the most widely used renewable energy source in the United States.

Hydroelectric plants transform the potential energy of water into electrical energy in three basic steps:

- water from a reservoir or diversion structure is carried through the air inlet to a turbine
- the falling water turns the turbine, which is connected to a generator, and
- the high-speed rotation of the generator coil generates electricity, which can then be transmitted to users through power lines.

The water above a dam possesses potential energy because its level is higher than that of the water downstream. The amount of energy in the falling water is directly related to how far it falls, a quantity called "hydraulic head." The amount of power that can be produced by the water is proportional to the head and the flow rate of the water.

The type of generation equipment for any hydro facility must take into consideration the characteristics peculiar to the specific site. Several different turbine types have been developed and adapted to the small-scale, low-head conditions common here in the Northeast. These turbines differ from large-scale equipment in that they are more capable of maintaining high conversion efficiencies over a wide range of flow conditions. The full potential of a site cannot be effectively developed without adequate consideration of turbine requirements in terms of head and flow.

Small-scale dams -- those with a rated capacity of less than 25 megawatts -- are often referred to as low-head dams. These small-scale dams are often operated "run of river." In other words, all of the water flowing downstream at any given time will flow through the dam; virtually no storage reservoir is created. Because a run-of-river dam does not store up a large amount of water, its power capacity varies with the changing flow rate of the river. A user whose need for power fluctuates in synchronization with river flows (which peak in spring and are low in summer) is often difficult to find. Several kinds of municipal loads, however, do meet the constraints of run-of-river hydropower. For example, public schools have high usage during the school year (September to June) and have virtually no usage in summer. In addition, the demand for municipal street lighting is high on long winter nights, and low on shorter summer nights.

<u>Economics</u>

Low-head hydroelectric installations tend to have higher equipment costs per installed kilowatt of capacity than do high-head units. Because the turbine diameter required to extract a given amount of power from the water increases quite rapidly as the head decreases, proportionally, low-head installations require larger equipment to produce the same amount of power. Operation costs for small-scale hydro, however, are lower, because the power source (the water) is free, and the dam requires little attention or maintenance.

The Northeast is dotted with hundred of old dams, since water power played a major role in the early industrial development of the region. The capital costs of installing a new hydropower plant at one of these old dams, however, can be high, since they involve feasibility studies, planning, and design, and upgrading the dam itself, as well as purchasing and installing the generation equipment.

Hydropower is a cheap form of electricity. Existing facilities produce it for as little as .35 cents per kilowatt-hour (kWh), and newly installed hydropower will cost between 1.5 and 8 cents per kWh. These costs compare favorably with 4-5 cents per kWh for nuclear power, 6-8 cents per kWh for coal, and 10 cents per kWh for combustion-generated electricity.[1]

Marketplace

Shortages and price increases for fossil fuels, as well as environmental considerations, have made hydroelectricity increasingly attractive over the last ten years, and have led to a new interest in developing the hydropower potential. A recent survey of hydro potential by the U.S. Army Corps of Engineers, Preliminary Inventory of Hydropower Resources, 1979, indicates that the nation's total hydro power potential is almost 513,000 megawatts, which is over eight times capacity at the existing 1,251 facilities. These figures, however, may be high, since they do not balance the potential for power generation against the competing uses for dams, such as recreation, flood control, irrigation, and drinking water; nor do they take into account the engineering, economic, and environmental factors that would constrain the full development of this potential. Estimates of the low-head hydro potential range from 13,000 to 58,000 megawatts, although recent studies tend to favor the lower figure. About half of this potential is at existing dams.

A small but significant boom in small-scale hydropower development is currently taking place. By far the largest category of these developers, both now and in the future, consists of municipalities, cooperatives and irrigation districts. These developers are favored by federal licensing requirements and have access to low-cost or tax-free capital for small-scale projects. Over 40 municipalities have license applications pending at present.

Barriers and Incentives

By far the largest direct benefit of municipal low-head hydro is the reduction of energy expenditures. However, additional benefits include potential reduction of pollution from less environmentally benigh sources (such as nuclear, coal and oil), and provision of a labor-intensive activity which could be carried out by a public works job corps. In addition, the power produced by small-scale dams may be cheaper than that of local utilities, and could be offered as an incentive for new industry to locate in an area, creating more jobs and new tax revenues.

Despite the attractiveness of hydro as a renewable, cheap energy resource, developers face a variety of limitations and constraints. First, hydropower must compete with conflicting demands on water supply, including flood control, recreation and ecosystem maintenance. In addition, because of the relatively high initial capital cost for small-scale hydro facilities, financing costs have a major impact on the price of the power produced, representing up to 90 percent of energy costs. However, once constructed, the energy produced by hydro is relatively immune to both inflation and rising fuel prices.

Outlook

Hydropower is one of the Northeast's most accessible energy resources. It is particularly well-suited to small-scale municipal generation.[1]

[1] "Rising Oil and Gas Prices are Making Hydropower Look Better Every Day," National Journal, April 26, 1980, p. 685.

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OVERVIEW

INDUSTRIAL PROCESS HEAT

Technology

Industry is the largest user of energy in the United States, consuming about 37 percent of the nation's total energy; approximately two-thirds of industrial energy is used for heat manufacturing processes. This "process heat," or thermal energy, is used to produce hot water, hot air, and steam that are used in the preparation and treatment of goods produced by manufacturing processes.

In theory, solar energy can be supplied in any form required by industry. In practice, however, the use of solar energy is currently most cost-effective at low or intermediate temperatures of 550^{0} or less. But, as illustrated in Figure 1 below, at least 27 percent of industrial process heat needs fall in this temperature range; and if preheating to 550^{0}F for higher temperature requirements is considered, 51 percent of industry's process heat can be supplied with available solar equipment. Depending on the temperature and form in which heat is needed, process heat can be supplied by flat plate collectors, evacuated tube collectors, parabolic troughs, or line-focusing solar concentrators.

The following are typical solar process heat applications:

- hot water for textile dyeing
- hot water for concrete block curing
- boiler feedwater preheat
- steam/hot oil for cooking
- hot air for crop drying

Economics

In most instances, solar process heat is not yet cost-competitive with energy from fossil fuels. To be competitive at today's fuel prices, solar collector system used in industry would have to be very inexpensive (less than $10 per square foot of collector, installed) and would have to deliver 200,000 BTU's per square foot per year. The first commercially viable system will most likely be constructed of low cost materials, such as plastics, and will operate at low temperatures (less than 160^{o}F). Obviously, increases in the prices of conventional fuels increase the economic feasibility of IPH as well.

Marketplace

There are approximately 25 solar process heat systems installed or under construction in the United States. Two of these are in the Northeast: a concrete block plant in Harrisburg, Pennsylvania and a precision metal tubing factory in Lanconia, New Hampshire. Costs are too high for a recognizable solar process heat equipment market to exist yet. Most process heat systems that have been installed have been in conjunction with Department of Energy field tests and demonstration projects.

Because of site-specific limiting factors, such as space available for collectors and potential for waste heat recovery, it is difficult to estimate the potential market in the Northeast for solar process heat. The most likely early commercialization opportunities for industrial application of solar are textile dyeing, food processing, concrete block curing and leather tanning.

However, it is possible to estimate the maximum possible contribution of solar based on the temperatures of industrial processes. Low temperature industrial processes (less than 180^{o}F), which will be the first to be heated by solar, account for 3 percent of industrial process heat (80 trillion BTU in the Northeast). Moderate temperature processes (less than 500^{o}), which have the potential of being heated by solar in the future, account for 25 percent of process heat (680 trillion BTU in the Northeast).

Barriers and Incentives

By far the largest barrier to solar industrial process heat is cost. If the price is attractive, industries will buy solar. At present, financial incentives include property and sales tax exemptions on solar equipment in most Northeast states, and federal investment tax credits totalling 25 percent, as follows:

15% alternative energy investment tax credit
+ 10% investment tax credit for manufacturing processes
25% total investment tax credit for
solar industrial process heat

Within the next decade, lower cost solar systems, achievable through standardized designs and mass production techniques, coupled with escalating prices and dwindling supplies of fossil fuels, should make solar more cost-competitive.

Land use sometimes presents another barrier to the adoption of solar industrial process heat systems, since the process may require a collector field too large or too heavy to be placed on a manufacturing facility's roof. Moreover, even when land is available, local zoning ordinances, or the cost of acquisition may preclude its use as a collector site.

Many of the benefits of a solar IPH system are not easily quantified, but are of increasing importance to industrial management. For example, a solar system can avert costly plant shutdowns caused by interruption of the fossil fuel supply. Furthermore, it offers an attractive opportunity for reducing air pollution without expensive retrofitting of existing equipment, which may also bring public relations benefits.

Outlook

Current solar systems are technically capable of significant contributions to the process heat needs of many industries. Though no real breakthroughs are expected in solar thermal technology, continued research and development

should produce systems which operate efficiently at higher temperatures. Although solar systems may not be economical today, many industrial process heat systems may be economical within the next 10 years, as the cost of fossil fuels and the price of constructing fossil-fuel heating systems increases because of the need for pollution controls.

What will make solar process heat competitive in the right application will be common sense design and practical engineering to put together materials and components to deliver energy at a reasonable cost.

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OVERVIEW

MUNICIPAL SOLID WASTE

Technology

The United States generates more than 135 million tons of municipal solid waste (MSW) annually. Its disposal is a rapidly growing problem for many areas of the country where traditional methods of disposal are proving to be either too expensive or environmentally unacceptable.[1] One promising solution, however, is energy recovery from refuse through a number of resource recovery techniques.

The knowledge of available and promising resource recovery technologies will serve as a valuable reference to smaller communities and towns considering a more advanced solid waste management program than the conventional sanitary landfill. Several resource recovery technologies are considered to be sufficiently developed to be available for commercial applications.

The primary consideration in producing energy from solid waste is the combustion of the refuse. Combustion technologies employ incinerator units to burn solid waste. The heat of combustion is transferred by a boiler system to produce steam. For incineration systems designed to market steam the generally accepted maximum steam line distance is about three miles. Distribution losses and transmission requirements will generally reflect an uneconomical system for greater distances. The four most common types of combustion technologies are examined below:

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1. Ch 7 P. 147 "Resource Recovery From MSW", Energy from Solid Waste: A Primer for Industry and Government. Northern Energy Corporation, 1981.

* Mass Burning. This term refers to combustion of the waste as received, although some facilities may shear or shred oversize materials before feeding to the incinerator. The two most common methods of mass burning processes involve refractory lined or waterwall units. Refractory lining refers to a resistant coating that both decreases the transfer of the heat produced from the combustion process to areas outside the incinerator unit and protects the outer shell of the unit from extremes and sudden changes in temperature. Waterwall units are so named because the walls of the furnace are lined with tubes filled with circulating water. The moving liquid acts as a coolant for the walls, which decreases the need for protective (refractory) lining of the entire furnace.

* Modular Incineration. Modular incineration is a term given to a variety of pre-fabricated, or modular, two-chamber combustion units used extensively in the combustion of waste from small-scale application. Similar to the large mass-burning units, the smaller modular units have been operated to produce hot water and steam. In addition, recent design developments have included the possibility of electrical generation through the incorporation of small-size turbine generators, although no systems are currently operating.

* Refuse Derived Fuel. The processing of MSW into various forms for use as a fuel supplement with coal or oil is unlike the strict incineration of unprocessed MSW. Essentially, the heterogeneous waste is processed to produce refuse-derived fuel (RDF) - a highly combustible, much more homogeneous fuel product than raw MSW. Since RDF is only a certain percentage of MSW and has a more combustible and controllable quality than MSW, overall furnace and boiler size (and therefore capital cost) can be decreased as compared to that needed for MSW. Since processing leads to the removal of certain inorganics, the heating value of waste in an RDF form is also higher (5,000 - 7,000 Btu/lb.) than the heating value of raw MSW (4,000 - 5,000 Btu/lb.).

• Pyrolysis. Pyrolysis involves the destructive distillation of the refuse solids in an oxygen-free or low-oxygen atmosphere at high temperatures. This process produces volatile gases, a liquid fuel, and carbon char. The low-Btu gas may be combusted on site in an after-burner to produce steam or used with the char to further fuel the reaction and produce pyrolytic oil as the energy end product.[2]

Economics

As the price of conventional fuels escalate and landfill costs and availability becomes increasingly restrictive, the viability of waste-to-energy systems will be enhanced. Current capital costs are in the range of $25-40,000 per ton of installed capacity. Thus, a conventional 200 ton per day facility for a community of 50,000 will cost approximately $2.5 - 4.0 million to design, procure and install. To cover such costs, and, ideally, collect surplus revenues the sale of recovered energy and materials must equal or exceed the annual debt service and operating costs. This contributes to the critical importance of a long-term guaranteed market in the form of an industry, utility, commercial or institutional customer for the steam, hot water and/or electricity generated at the plant.

Barriers and Incentives

Assuming that MSW energy production is cost effective for your community, the single greatest barrier to its implementation might very well be its actual or perceived negative impact on the local environment. Heavy metals and toxic substances are often present in municipal solid waste and these could contaminate the environment by polluting the air or by leaching from ash

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2. New England Energy Atlas, pp. 33-34.

disposal sites. Other potential environmental effects might include air pollution, noise and congestion as a result of the facility's location and operation, although operating facilities on the small and medium-scale range have demonstrated few such problems.[3]

Marketplace

Without a stable market, a waste-to-energy project cannot achieve economic viability. To date, most communities have found markets in local industries with substantial process steam requirements. These typically include the paper, textile and chemical plants which utilize steam in their manufacturing operations. As the cogeneration of steam and electricity become more common, additional market opportunities will emerge in other sectors. Recovered materials, e.g., glass, ferrous materials, aluminum and ash also offer opportunities to increase revenues, particularly in large plants in which the volume of materials makes recovery economics particularly attractive.

Because of the many and varied environmental considerations associated with MSW, the siting of such a facility is critical. As such, it is important to keep this in mind in all of your land use planning activities, especially in parcels zoning for industrial uses where potential new customers are located.

Outlook

Waste-to-energy facilities promise to make a significant contribution to community energy self-sufficiency as a new generation of technologies are thoroughly tested and operated. The dual advantages of waste management and energy production in an environmentally compatible fashion will enhance the attractiveness of waste-to-energy projects. A community can facilitate this process through its zoning and master planning activities.

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3. New England Energy Atlas, p. 35.

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OVERVIEW

PHOTOVOLTAICS

Technology

The photovoltaic effect is the process that occurs when light hits certain sensitive materials and creates a flow of electrons -- an electrical current. A typical photovoltaic cell contains two very thin layers of silicon with an outside wire attached to each layer. In one layer, a few atoms in the silicon wafer have been replaced by a "dopant" element that will accept excess electrons, like boron; in the other, the replacement atoms are electron-donors, often phosphorus. Sunlight falling on the donor layer forces electrons to move along the wire to the acceptor layer, creating a flow of electricity. Large numbers of these silicon wafers, or photovoltaic cells, can be connected electrically to form solar panels, which are the building blocks of solar electric systems. The electrical current obtained from the cell is directly proportional to the area receiving light. Today, a photovoltaic panel can produce about 100 watts of electricity per square yard of area covered.

Economics

The cost of solar energy is measured in terms of cost per peak watt, or the maximum amount of solar energy generated by the cell during favorable conditions. In 1958, the cost was approximately $2,000 per peak watt. Today, the cell cost averages between $8 and $10 per peak watt. For a total array, energy costs are approximately twice this - or $16 to $20 per peak watt. The Department of Energy's goal of $.70 (in 1980 dollars) per peak watt by 1986 is

considered attainable, and even conservative, by some experts in the field. At this price, photovoltaic electricity will be cost-competitive with utility rates in many cities today.

Marketplace

Though photovoltaics is not yet widely commercialized, many cost-effective uses for the technology exist today. Photovoltaics is still used in spacecraft as it was in the 1950's. In addition, these solar systems are used to provide electricity in areas where there are no existing power lines or public utility systems. For example, these solar systems are being used today as power supplies for:

Communications -- electronic microwave receiving and transmitting devices usually located in remote areas; emergency call boxes on remote roadways.

Railroad Signals -- electric power for warning lights, railroad crossing signals, track signals, stoplights and cabooses.

Navigational Aids -- marker buoys, channel markers, foghorns and oil platform lights.

Data Transmission -- devices that measure and transmit water level, snowfall and seismic data from remote areas.

Water Pumping -- water pumps used for remote stock watering, village drinking water and irrigation.

Lighting -- highway and commercial signs.

Cathodic Protection -- prevention of corrosion in underground pipelines.

Today, less than twenty companies worldwide are in the commercial market for photovoltaics. Independent forecasters predict that the world market will top $100 million in 1982, and will exceed $1 billion by the year 2000.

Barriers and Incentives

Cost is the greatest barrier to widespread commercialization of photovoltaics. Even at today's much-reduced prices of $8 to $10 per peak watt, electricity generated by photovoltaic conversion is still far too expensive for all uses but those listed above.

In principle, no major technological breakthrough is needed in the technology to achieve cost-effectiveness. Improvements in manufacturing techniques and generating efficiency could cut costs sufficiently to make current photovoltaic technology cost-competitive. Presently silicon cells are primarily hand-made, and labor accounts for more than a third of the cost of manufacture. Waste of the purified silicon component accounts for another substantial portion of the cost. New manufacturing techniques are currently being developed to cut both labor and material costs.

Outlook

As the photovoltaic cell/array production process becomes more automated and volume increases, the cost of photovoltaic electricity is expected to drop each year, achieving the Department of Energy's goal of $.70 per peak watt by the year 1986. At this price, photovoltaic power will be cost-competitive with energy derived from fossil fuels.

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Minnesota Energy Agency, Solar Access Workbook, St. Paul, MN; Minnesota Energy Agency, 1981.

Morris, David; Cities, Energy and Self Reliance, Washington, D.C.; Institute for Local Self Reliance, 1979.

Office of Appropriate Technology, State of California, Local Energy Initiatives: A Survey of Cities and Counties, California 1980, Sacramento, CA, Office of Appropriate Technology, August 1980.

Ontario Ministry of Energy, Perspectives on Access to Sunlight, Toronto, CN; Ontario Ministry of Energy, 1978.

Schweitzer, M.; Review of Legal and Institutional Issues in the Use of Decentralized Solar Energy Systems; Tennessee, Oak Ridge National Laboratory, April 1980.

Shapiro, Michael; Boston Solar Retrofits: Studies of Solar Access and Economics: Cambridge, MA, Energy and Environmental Policy Center, John F. Kennedy School of Government, Harvard University, December 1980.

Smith, P.L.; McCreary, S.T.; Methodology for Evaluating Physical Constraints on Residential Solar Energy Use: Berkeley, CA; Lawrence Berkeley Laboratory, October 1978.

U.S. Department of Energy, Community Impediments to Implementation of Solar Energy, Washington, D.C.; DOE Technology Assessments Division, 1979.

Watson, D.; Energy Conservation Through Building Design, New York, NY; McGraw Hill Inc., 1979.

III. RESOURCE ORGANIZATIONS

- Air-Conditioning & Refrigeration Institute
  1815 North Fort Myer Drive
  Arlington, Virginia 22209
  (703) 524-8800

  Formed Air Conditioning & Refrigeration Institute Foundation (ARIF) to draft rating standards for collectors and identify procedures necessary to establish a certification program for collectors. Presently under NBS contract to identify collector testing laboratories using ASHRAE standards.

- American Institute of Architects (AIA)
  American Institute of Architects Research Corporation (AIARC)
  1735 New York Avenue, NW
  Washington, D.C. 20006
  (202) 785-7248

  Publications: Survey of Passive Solar Buildings, Energy Conservation in Building Design, New Design Concepts for Energy Conserving Buildings, Basics of Solar Heating and Hot Water Systems, AIA Journal, AIA Memo, Energy Notebook series brochures on solar and conservation.

- American National Standards Institute
  1430 Broadway
  New York, New York 10018
  (212) 354-3300

- American Planning Association
  1313 East 60th Street
  Chicago, Illinois 60637
  (312) 947-2560

  Publications: Site Planning for Solar Access, Protecting Solar Access for Residential Development, Manual of Community Architecture (in conjunction with HUD); Planning Advisory Service Reports, information on energy conservation regulations, solar access, solar design, and solar energy use.

- American Planning Association
  Energy Planning Division
  P.O. Box 172
  Vienna, Virginia 22180
  (703) 827-7040

  Publications: Energy Planning Network newsletter.

- American Section/International Solar
  Energy Society (AS/ISES)
  Research Institute for Advanced Technology
  U.S. Highway 190 West
  Killeen, Texas 76541
  (817) 526-1300

  Uses and applications of solar energy; has the following state and regional chapters (see information under each state): Alabama, Arizona, Colorado, Georgia, Illinois, Indiana, Kansas, Michigan, Mississippi, Nebraska, New England, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pacific Northwest, Pennsylvania, Tennessee, Texas, Virginia, Wisconsin.

  Publications: Solar Age (monthly), Solar Energy (bimonthly), Sun World (quarterly), ISES News (international newsletter), Annual Membership Directory, conference proceedings, books, reprints, educational materials.

- American Society of Heating, Refrigeration
  and Air-Conditioning Engineers
  345 East 47th Street
  New York, New York 10017
  (212) 644-7853

  Developed widely used standards for testing the performance of thermal storage and collectors, both flatplate and evacuated table.

- American Society of Mechanical Engineers
  United Engineering Center
  345 East 47th Street
  New York, New York 10017
  (212) 644-7722

  Developed Optimal Standard for Controllers used in solar heating systems. Presently developing information on heat transfer fluids.

- American Wind Energy Association
  1621 Connecticut Avenue, SW
  Washington, D.C. 20009
  (202) 667-9137

  Publications: AWEA Windletter, Wind Technology Journal: also publishes information on research contracts, conference proceedings, and items of general interest.

Sponsors two conferences each year, which include presentations and exhibits. Provides legislators with necessary information to make assessments of wind as an energy source. Offers participation in funded research projects and assistance in proposal preparation.

- Center for Neighborhood Technology
  570 West Randolph Street
  Chicago, Illinois 60606
  (312) 454-0126

  Publications: "The Neighborhood Works" published twice monthly, a newsletter reporting on "low" technologies feasible in a neighborhood setting.

- Center For Renewable Resources (CRR)
  1001 Connecticut Avenue, NW
  Suite 510
  Washington, D.C. 20036
  (202) 466-6880

  Publications: Shining Examples: Model Projects in Renewable Energy, Sources of Funds for Solar Energy Projects, educational information and brochures on solar energy.

- Coalition of Northeast Municipalities
  131 Tremont Street
  Boston, Masschusetts 02111
  (617) 542-5444

  Publications: Northeast Municipal Conservation Initiatives, Directory of Northeast and National Organizations, and Other Analyses and Handbooks.

  Formed in 1977 to assist distressed Municipal Governments in New England, New York, New Jersey and Pennsylvania; addresses the fiscal economic development and energy conservation problems facing the region's cities and towns; administered by The New England Municipal Center (NEMC).

- Community Services Administration
  1200 19th Street, NW
  Washington, D.C. 20506
  (202) 655-4000

  CSA, primary sponsor of the National Center for Appropriate Technology, is spearheading the bulk of current Federal programs aimed at making solar technologies available to low-income people.

- Department of Energy
  Local Affairs Branch, Intergovernmental Affairs
  1000 Independence Avenue, SW
  Washington, D.C 20585
  (202) 252-5661

- HUD Community Planning Department
  451 7th Street, SW
  Washington, DC 20410
  (202) 755-6270

- International Association of Plumbing & Mechanical Officials
  5032 Alhambra Avenue
  Los Angeles, California 90032
  (213) 223-1471

  Issued the Uniform Solar Energy Code, which details a set a minimum requirements and standards for protection of public health, safety and welfare. Code provisions apply to the erection, installation, alteration, addition, repair, relocation, replacement, maintenance or use of solar systems. Also provides for accreditation of solar domestic hot water systems.

- International City Manager's Association
  1140 Connecticut Avenue, NW
  Washington, D.C. 20036
  (202) 293-2200

- Library of Congress, Science and Technology Division
  10 1st Street, SE
  Washington, D.C. 20540
  (202) 282-5000

  The library has material on solar, wind, and tidal power; answers questions from the public and makes referrals.

- Metropolitan Solar Energy Society
  P.O. Box 2147
  Grand Central Station
  New York, New York 10163

  A chapter of the American Section of ISES; arranges solar building tours and special interest solar conferences; engaged in a Solar Town Meetings program throughout the Tri-State New York metropolitan area; holds meetings every six weeks.

  Publications: Solar Action Newsletter and Resource Guide.

- Mid-Atlantic Solar Energy Association (MASEA)
  2233 Grays Ferry Avenue
  Philadelphia, Pennsylvania 19146
  (215) 963-0880

  Publications: Solar Glazing Proceedings, Passive Solar: State of the Art, Site Built collector Proceedings, "The Solar News", quarterly newsletter.

- National Association of Counties
  1735 New York Avenue, NW
  Washington, D.C. 20006
  (202) 785-9577

- National Association of Home Builders
  15th and M Streets, NW
  Washington, DC 20005
  (202) 452-0200

  Publications: (available to NAHB members only) Builder, Economic News Notes, Library Bulletin, Homes and Homebuilding, Designing and Building a Solar Home, Solar Energy for Homeowners: also bibliographies, booklets and manuals.

  Resource group for builders, has library with material on energy conservation and solar; provides information on thermal performance guidelines for single-family dwellings and apartments in various geographic regions.

- National Bureau of Standards
  Building 225A 114
  Washington, D.C 20234
  (202) 921-3285

- National Center for Appropriate Technology
  P.O. Box 3838
  Butte, Montana 59701
  (406) 494-4572

  Publications: Briefs, Bibliographies, monographs and research reports.

  NCAT develops and applies appropriate technologies to the energy-related needs and problems of low-income people and communities and is funded by the Community Services Administration. Its primary areas of research and technical assistance include solar energy applications, agricultural waste recycling, biomass conversion, housing and transportation.

- National Community Energy Management Center
  400 N. Capital Street, NW
  Suite 390
  Washington, D.C. 20001
  (202) 638-1445

- National League of Cities
  1620 I Street, NW
  Washington, D.C. 20006
  (202) 293-7310

- National Oceanic & Atmospheric Administration
  National Climatic Center
  Asheville, North Carolina 28801

- National Solar Heating & Cooling Information Center
  P.O. Box 1607
  Rockville, Maryland 20850

  800-523-2929 (toll free)
  800-462-4983 (toll free in Pennsylvania)

  Publications: Bibliographies and Fact Sheets

- National Weather Service
  8060 13th Street
  Silver Spring, Maryland 20910
  (301) 427-7689

- New England Solar Energy Association
  (Chapter of American Section/International Solar Energy Society)
  P.O. Box 541
  Brattleboro, Vermont 05301
  (802) 254-2386

  Publications: Newsletter, covering technology developments, events, book reviews, Solar Booklist, 1979 Solar Greenhouse Conference Proceedings.

  Maintains resource library for members: provides slide sets on solar greenhouses and site-built collectors; host of Fifth National Passive Solar Conference (Passive '80).

- Northeast Solar Energy Center
  470 Atlantic Avenue
  Boston, Massachusetts 02210
  (617) 292-9250

  Department of Energy's lead institution for solar research and development.

- Solar Energy Industries Association
  10001 Connecticut Avenue, NW
  Washington, D.C 20036
  (202) 293-2981

  Publications: Newsletter, SEM 79 (solar product directory), Solar Advertising Guidelines, Solar Warranty Guidelines, Solar Engineering Magazine

  Trade organization for manufacturers, distributors, and designers of solar energy equipment, promotes and lobbies for increased use of solar energy.

- Solar Energy Research Institute
  1617 Cole Boulevard
  Golden, Colorado 80401
  (303) 231-7356

IV. SAMPLE ORDINANCES

An Introduction to the Resources Section: Solar Energy Ordinances

There are a variety of solar regulations which are emerging to address the multifaceted problems created by the development of solar energy systems an the protection of solar access. As of June 1981 there were as many as 40 different adopted solar regulations throughout the United States. Most of t adopted regulations address a variety of issues. However, for the sake of clarity, it is helpful to isolate the distinct regulatory approaches which are emerging. Solar regulations can be classified into six distinct types:

1. Regulations removing existing barriers:

   Typical regulations that have addressed the removal of legal barriers to the use of solar energy systems have focused on the relaxation of setbacks requirements and providing building height exemptions for solar energy systems. The Governments of Del Mar, California, the County of San Diego, California, Madison, Connecticut and Ferrisburgh, Vermont have all attempted to remove legal barriers from their zoning ordinances. The adopted regulations for Del Mar, California are perhaps the best example of this regulatory approach and are included in the resource section.

2. Regulations requiring solar conscious subdivision design

   One of the most significant areas of regulatory reform involves the adoption of the subdivision amendments which encourage proper orientation of houses, lots and streets. This regulatory approach is one of the most popular approaches since it ensures that all future development is properly oriented to maximize the use of solar energy for space heating or domestic hot water. The Governments of Middlebury, Connecticut, Southbury, Connecticut, Madison, Wisconsin, Sacramento, California, Denver, Colorado, Santa Clara County, California, Port Arthur, Texas, Aspen, Colorado, Lincoln, Nebraska, Los Alamos, New Mexico, Ferrisburgh, Vermont, Naugatuck, Connecticut, and Albuquerque, New Mexico have included regulations containing policies on solar conscious street, lot or building orientations. The adopted regulations for Southbury, Connecticut are perhaps one of the best examples of this approach since their regulations have addressed solar conscious street, lot and building orientations. A copy of Southbury's regulations are included in the resource section.

3. Regulations providing incentives for the utilization of solar energy systems

   Several municipalities in the United States now offer density bounuses or reduced development costs to builders and developers who include solar energy and energy conservation considerations into new developments. The most significant incentive regulations for solar energy systems are those adopted by Loncoln, Nebraska and Ashland, Oregon. Both of these local governments offer density bonuses in exchange for the mandatory installation of solar energy systems, and the proper orientation of streets and lots. A copy of one regulation adopted by Lincoln, Nebraska is included in the resource section.

4. Regulations utilizing solar energy considerations as a factor in selecting new growth.

Growth Management regulations and Planned Development regulations have utilized solar energy considerations as a factor in evaluating the overall suitability of certain types of new development proposals in certain areas of the United States. For example, Boulder, Colorado controls the amount of new multi family housing through a Residential Allocation System which evaluates the merits of new development proposals based on a variety of factors including its energy efficiency and its use of solar concious siting and building practices. Boulder's Residential Allocation System for Multi Family Development proposals is included as an example of this regulatory approach in the resources section.

5. Regulations mandating the installation of solar energy systems in new development

A growing number of California counties and cities have adopted local ordinances requiring the installation of solar energy systems in all new residential developments. Counties and municipalities which have required the installation of solar energy systems have generally limited the requirement to domestic hot water heating or swimming pool heating involving new construction. However, at least one municipality requires the retrofit installation of solar domestic hot water systems on all residential units sold after]982. Perhaps the best examples of this mandatory approach are in southern California. They include, San Diego County, California, Santa Clara County, California, Santa Barbara County, and Davis, California. A copu of the San Diego County Ordinance is included in the resource section.

6. Regulations protecting solar access

Solar access protection has become a dominant consideration in many local regulatory approaches. The method of protecting solar access varies dramatically amongst these local governemtns which have adopted standards for solar access protection.

Two basic regulatory approaches have emerged: (1) lot by lot solar access protection accomplished through a solar access recordation permit, and (2) area wide solar access protection accomplished through uniform standards for the siting of solar energy systems and the level of solar radiation to be provided to solar energy systems within each zoning district of the municipality. The Solar Access Recordation Permit approach is being used in Woodburn, Oregon and requires a case by case analysis of the solar access available to each solar energy system prior to the issuance of a permit guarranteeing total protection from shadows cast by new buildings on construction and new vegetation to the south of the solar energy system. The area wide protection approach has been accomplished in a variety of ways including the sue of solar bulk planes (Albuquerque, New Mexico), Solar setback provisions (Ashland, Oregon), protecting solar access by the use hypothetical south wall on the lot line (Los Alamos, New Mexico), reduced building height standards within specific zoning districts to protect solar access (Albuquerque, New Mexico), limiting variances to building heights or controlling building height exemptions to protect solar access (Wolcott,

Connecticut) and establishing public control over vegetation to control one of the most significant threats to solar access (Woodburn, Oregon). A copy of the Albuquerque, New Mexico, Ashland, Oregon, Los Alamos, New Mexico and Woodburn, Oregon ordinances are included in the resource section.

CITY OF ALBUQUERQUE, NEW MEXICO

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ORDINANCE

AMENDING ARTICLE XIV OF CHAPTER 7 OF THE REVISED ORDINANCES OF ALBUQUERQUE, NEW MEXICO, 1974, THE COMPREHENSIVE CITY ZONING CODE, RELATING TO SOLAR ACCESS.

BE IT ORDAINED BY THE COUNCIL, THE GOVERNING BODY OF THE CITY OF ALBUQUERQUE:

Section 1. Section 2.A of Article XIV of Chapter 7 of the Revised Ordinances of Albuquerque, New Mexico, 1974, is hereby amended to read as follows:

"A. This ordinance is intended to help achieve Article IX of the Charter of the City of Albuquerque and the city's master plan, in particular the master plan documents which comprise the Albuquerque/Bernalillo County Comprehensive Plan. This ordinance is intended to create orderly, harmonious, and economically sound development in order to promote the health, safety, convenience, and general welfare of the citizens of the city. These regulations are necessary to provide adequate open spaces for light and air including solar access; to avoid undue concentration of population, to secure safety from fire, panic, and other dangers; to help control congestion in the streets and public ways; to control and abate unsightly use of buildings or land; to facilitate adequate provisions for community utilities and facilities such as transportation, water, sewer, schools, and parks; to encourage the most appropriate use of land; to properly channel flood water runoff; to conserve and stabilize the value of property; and to enhance the appearance of the landscape."

City's evaluation."

Section 4. Section 10.D of Article XIV of Chapter 7 of the Revised Ordinances of Albuquerque, New Mexico, 1974, is hereby amended to read as follows:

"Lot size. Minimum lot area shall be 6,000 square feet. Minimum lot width shall be 60 feet, except that on all streets oriented north and south or within 30 degrees of this axis, minimum lot width in subdivisions for which plats are submitted after February 1, 1981, shall be 65 feet. Provided, however, that the 65 foot lot width requirement shall not apply if there are other means of assuring solar access to the lot, or the nature of the existing or approved future development contiguous to the lot precludes solar access to it."

Section 5. Section 10.E of Article XIV of Chapter 7 of the Revised Ordinances of Albuquerque, New Mexico, 1974, is hereby amended by inserting a new subsection to read as follows:

"3.d For lots in subdivisions for which plats are submitted after November 1, 1980 and which front on streets which are oriented due North-South or within 30 degrees from this orientation, the minimum side yard setback on the southerly side shall be either:

(1) 15 feet if the immediately adjacent side yard setback is 5 feet or less, or

(2) 10 feet if the immediately adjacent side yard setback is 5 feet or more.

In no case shall the distance between two residential buildings be less than 15 feet.

Setback lines shall be as indicated on the final plat (by note, reference or dimension) or as recited in the Restrictive Covenants filed with the plat. In absence of the above, the setbacks shall be herein defined and the minimum side setback for lots within the provisions of Section 10.E.3.d shall be 10 feet on the South side and 5 feet on the North side of each lot, except that on a corner lot the side yard setback on the street side must be at least 10 feet."

Section 6. Section 40.C.1.b of Article XIV of Chapter 7 of the

feet. In any subdivision for which the preliminary or preliminary/final plat is submitted to the City after February 1, 1981, the height of any building shall comply with one of the following additional height limitations, either:

(1) The building height shall not exceed the following heights, determined by the distance cardinally south from the northern boundary of the lot as follows:

Distance Cardinally South From Northern <u>Lot Line</u>	<u>Height</u>
0-5 feet	8 feet except 10 feet for townhouses with a party wall at the subject lot line
5-10 feet	10 feet
10-15 feet	13 feet
15-20 feet	15 feet
20-25 feet	17 feet
25-30 feet	19 feet
30-35 feet	21 feet
35-40 feet	23 feet
40-45 feet	25 feet or alternatively

(2) The height shall not exceed a 23-degree-angle plane (as further defined in paragraph (c) below) drawn upward from a horizontal line located two feet above the mean grade at either:

(a) A line lying ten feet within the lot lying to the north and parallel to the general south side of the neighboring lot which is most nearly perpendicular to cardinal north, if the lot is vacant and no building permit for a structure has been applied for; or

(b) The facade of the principal residential building on the lot lying to the north, which most nearly faces cardinal south if the lot has an existing building intended for permanent occupancy or a building permit for such a structure has been issued.

(c) The plane shall be made up of lines drawn cardinally south, 23 degrees above horizontal, along all points identifying said southerly setback lines or building lines.

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Severability Clause. If any section, subsection, sentence, clause, word or phrase of this ordinance is for any reason held to be unconstitutional or other wise invalid by any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this ordinance. The Council, the Governing Body of the City of Albuquerque, hereby declares that it would have passed this ordinance and each section, subsection, sentence, clause, word, or phrase thereof irrespective of any one or more sections, subsections, sentences, clauses, words or phrases being declared unconstitutional or otherwise invalid.

Section 11. Compiling Clause. This ordinance shall be incorporated in and compiled as a part of the Revised Ordinances of Albuquerque, New Mexico, 1974.

Section 12. Effective Date and Publication. This ordinance shall become effective five days after publication in full.

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ASHLAND, OREGON

Chapter 18.70

SOLAR ACCESS

Sections:

18.70.010 Purpose and Intent. The purpose of the Solar Access Chapter is to provide protection of a reasonable amount of solar access to all parcels in the City so that investments in solar equipment may be secure, and further use of solar energy will be encouraged. This protection should weigh equally on both the receiving property owner and the property owner which will potentially shade the receiving property owner.

18.70.020 Definitions. As used in this Chapter, the following terms shall have the meanings shown:

1. "Buildable area." That portion of a lot excluding the minimum setback area.

2. "Collector surface." Any part of a solar collector that absorbs direct solar energy for use in the collector's energy transformation which shall include solar aperture (windows & greenhouses) in passive solar design. It does not include such items as frame supports and mounting hardware.

3. "Collector use period."

   a. For solar space heating collectors, or for collectors used for both space heating and cooling, 10 AM to 2 PM local solar time during September, October, November, January, February, March, and April.

   b. For solar hot water heating collectors or photovoltaic generators, 10 AM to 2 PM local solar time for the entire year.

   c. In the case of any amendment to the collector use period, the collector use period as defined on the date of issue of the solar collector recordation shall apply. A recorded owner may apply for a new recordation granting the new period of protection if a longer collector use period is promulgated.

4. "Development permit." Any permit or authorization issued by the City as a prerequisite for undertaking any development. It includes permits and authorizations customarily known as building permits, rezoning approvals, variances, conditional uses, partitionings, subdivisions, or performance standards development permits.

Where

S = setback from property line

a = solar altitude, 22°

$$s = \text{slope} = \frac{\text{Northerly elevation 1 - Southerly elevation 2}}{\text{Distance between E1 \& E2}}$$

H = height of shadow-casting portion of building

d. No setback shall be required by this ordinance which shall be greater than 80 feet.

e. All setbacks and slopes shall be measured 30° east and 30° west of north.

2. If the setback required under paragraph 1 above cannot be met by the proposed structure, then the following method shall be used to determine the setback. The actual shadow length to be cast by the proposed structure shall be determined by the following formula:

Where $a > \tan^{-1}/s$, and where $s > 0$

$$S = \frac{\sin(90 - a)}{\sin(a + \tan^{-1} s)} \cdot \cos(\tan^{-1}/s/) \cdot H$$

Where

S = setback from property line

a = solar altitude, 22°

$$s = \text{slope} = \frac{\text{Northerly elevation 1 - Southerly elevation 2}}{\text{Distance between E1 \& E2}}$$

H = height of shadow-casting portion of building

The Staff Advisor shall then determine whether or not the shadow is cast upon a south or east facing portion of any existing building or onto the buildable area in an undeveloped parcel. Setbacks shall then be sufficient to ensure that no shading of a south or east wall, or shading into the buildable area of a vacant lot's south or east sides will occur.

If the setback is along a slope of less than -.10, any variance to this requirement shall be a Type I procedure.

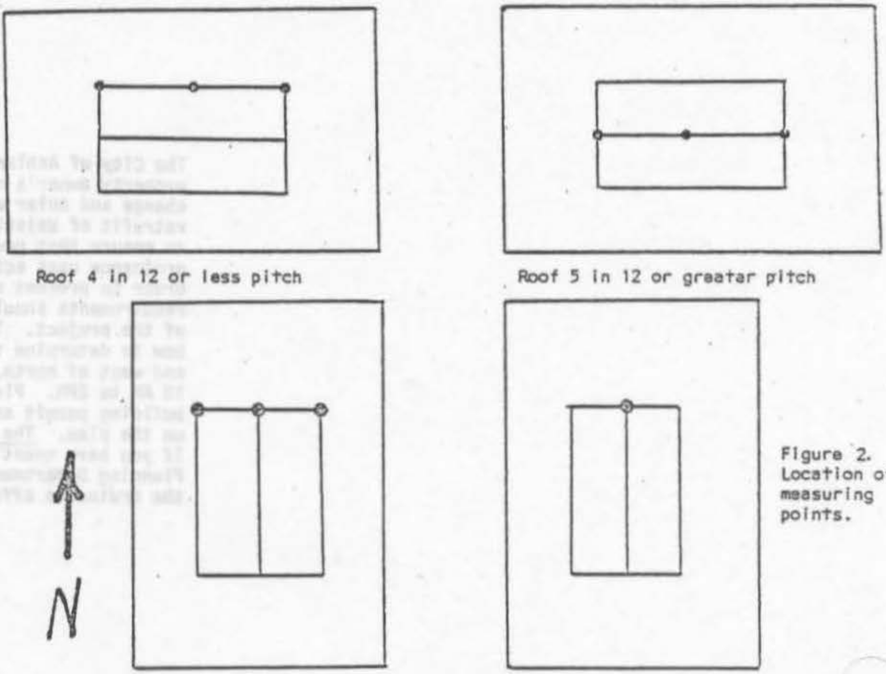
3. If neither of the above two criteria will result in a setback which would allow development of the property by a structure whose shadow-casting portion is no higher than 16 feet at its highest point, and the setbacks are along slopes of greater than -.10, and which otherwise meets all minimum requirements of the Land Use Ordinance, then the Staff Advisor shall determine whether or

SOLAR SETBACK INFORMATION SHEET

The City of Ashland has recently enacted a Solar Access Ordinance which protects property owner's right to sun. This concept is very important as energy needs change and solar energy becomes more important, both for new structures and the retrofit of existing structures for solar hot water or photovoltaics. In order to ensure that new development does not cut off other people's sunlight, the ordinance uses actual shading patterns to determine the north side setback. In order to prevent costly delays or modification of plans, solar access setback requirements should be dealt with at the very beginning of the planning phase of the project. The City has developed an instruction handout which explains how to determine the north side setbacks. These setbacks are measured 30° east and west of north, as solar access is being protected between the hours of 10 AM to 2PM. Plot plans submitted to the Building Department as part of a building permit are not complete unless the solar access information is included on the plan. <u>The plans will not be processed until this information is included</u>. If you have questions concerning how to figure the setback, please contact the Planning Department and we will be more than willing to help you determine how the ordinance affects your project.

tep 2.

The next step is to choose the points on the building which the setback will be measu
to. Figure 2 shows the location of the measuring point on four different buildings. As you can see, the difference is the roof pitch and whether the units are oriented in a north/south access or in an east/west access. These buildings are relatively simple in their configuration, however, the same principles will apply to more complicated roof configurations including hip and Dutch hip roofs.



Roof 4 in 12 or less pitch

Roof 5 in 12 or greater pitch

Roof 4/12 or less in pitch

Roof 5/12 or more in pitch

Figure 2.
Location of measuring points.

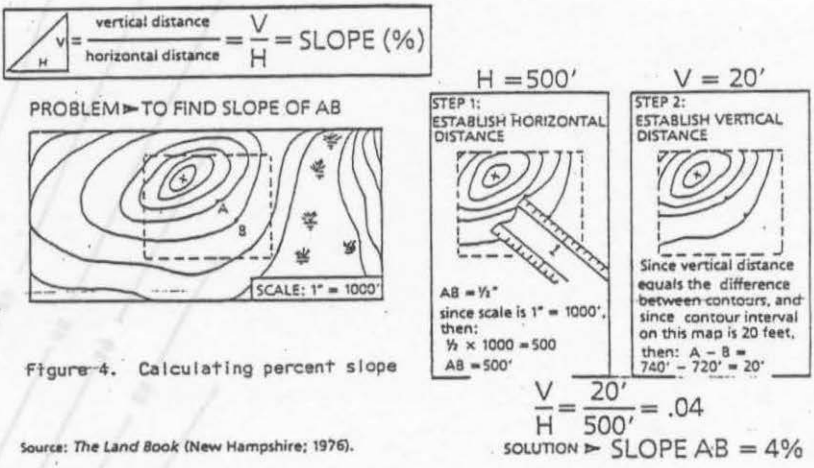


Figure 4. Calculating percent slope

Source: *The Land Book* (New Hampshire; 1976).

Step 4.

The next step is to take the information off the plot plan and find the solar setback on Graph 1. An example is shown in Fig. 5. Find the height of the building on the line whi runs vertically on the page. Then find the slope on the line which runs on the bottom of the page. Draw a horizontal line thru the height and vertical lines thru the slope at the bottom of the page. Where these lines intersect, read off the solar setback just as you would elevation off a topographic map. As shown in Fig. 6, the solar setback has been met by the building.

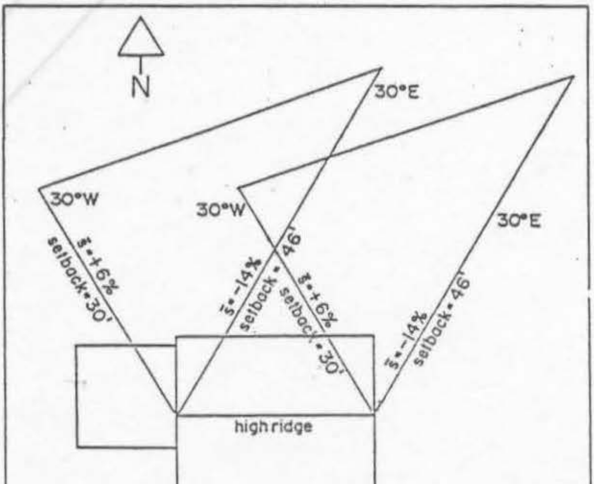
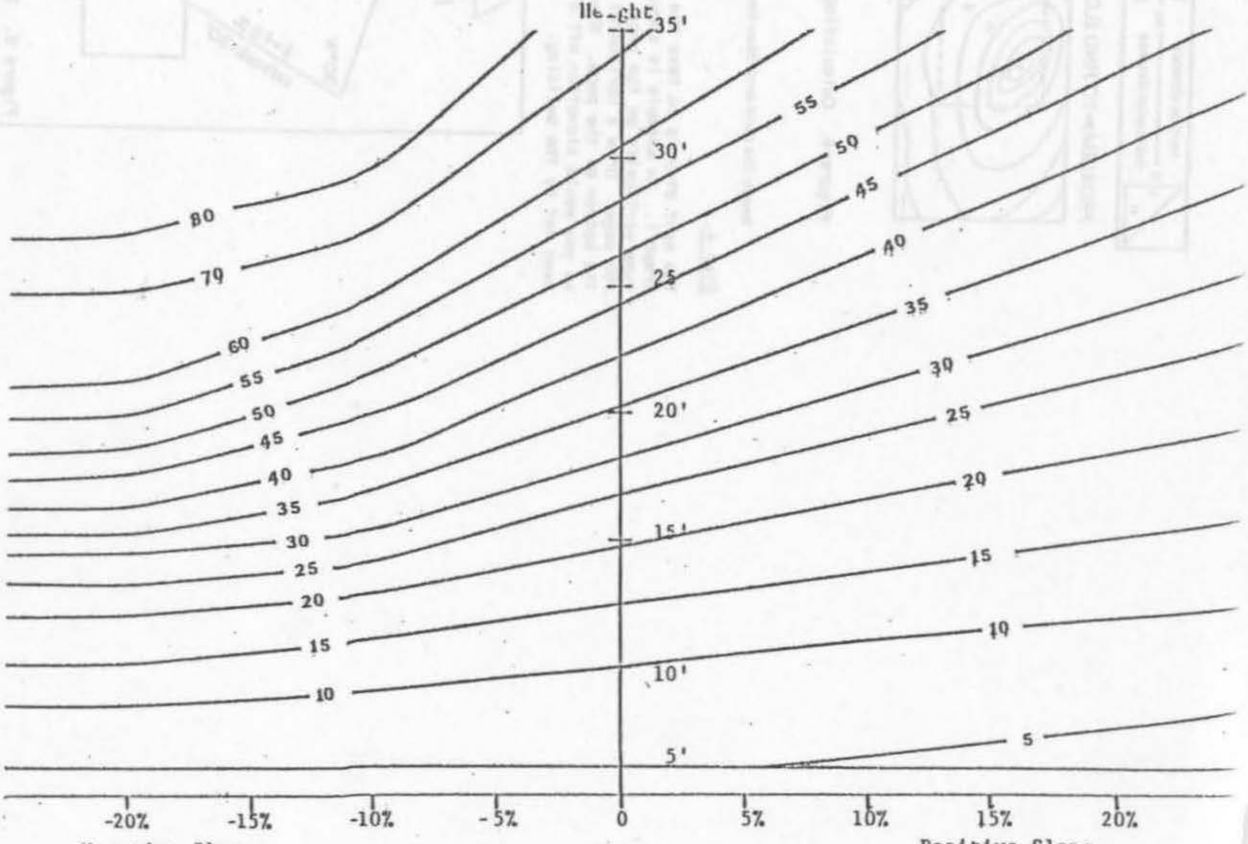


Figure 6. Sketch showing application of setbacks to proposed home.



CITY OF ASHLAND SOLAR SETBACK CALCULATOR

Step 5.

There are many situations, however, where this will be impossible to meet the setbacks. If this is the case, go to graph 2. Using the same procedure as you did on graph 1, select the two elevations off of graph 2. This is the actual distance that a shadow will be cast on February 21. Measure this distance out on the ground or plan. If it does not intrude onto the south or east wall of an existing structure, or onto a buildable lot which has not been developed to the north, (for example, if the shadow simply falls in the street or parking lot) then the permit may be issued without a variance for any further problem. If you can not meet this setback, then there are several different methods or alterations to the site which could be made to meet the setback. First of all, can you alter the building location and meet the setbacks? If you can't, can you alter where the highest part of the building is located? For examp on a split level house, the highest part could be located on the south side of the property rather than the north side. Or if the gable end is facing north, can you provide a hip roof rather than a gable roof which would bring the highest point in several feet from the north property line. Thirdly, if none of the two above are possible, can you alter the building height. In other words, can you set the building into the ground a couple of feet and meet the setback?

If this is not possible, then consult the planning staff. What will be done is determine if all reasonable efforts have been made to meet the solar setback and if the solar setback still can not be met, then if roof top access (sun on Jan. 21 on the roof of the structure to the north rather than the south wall) can be guaranteed. This is much easier to provide than the south wall access. If this access can not be provided, then the Type I variance must be filed for relief from the setback. Only in this case will there be notification of the northerly property owner.

If at any time you need assistance from the Planning Department, please feel free to drop by and we will spend as much time as needed to help you compute your calculations.

Planning Department
Los Alamos, New Mexico 87544

Excerpts from the Los Alamos County Zoning Code, effective May 1, 1980 (Code Ordinance 74-38, as adopted).

Solar Energy Collection System

a. When a solar energy collection system is installed on a lot, accessory structures or vegetation on an abutting lot shall not be located so as to block the solar collector's access to solar energy. The portion of a solar collector that is protected is that portion which:

(1) is located so as not to be shaded between the hours of 10:00 a.m. and 3:00 p.m. by a hypothetical 12-foot obstruction located on the lot line; and,

(2) has an area not greated than one-half of the heated floor area of the structure, or the largest of the structures, served.

b. This subsection does not apply to accessory structures or vegetation existing in an abutting lot at the time of installation of the solar energy collection system, or on the effective date of this Code, whichever is later. This subsection controls any accessory structure erected on, or vegetation planted in, abutting lots after the installation of the solar energy collection system.

c. A statement that a solar energy collection system is to be installed on a lot shall be filed and recorded with the County Clerk on the day the building permit for the solar system is issued, and the dated of installation shall be the date of recordation. The solar facility must be completed and have a final inspection, approved by the Chief Building Inspector, within one year from the date of installation.

Definitions (Section III)

solar energy collection system, active - means a mechanical system for heating or cooling a structure by collecting, storing and transporting solar energy.

solar energy collection system, passive - means a system that employs siting and orientation, structural materials and landscaping to take advantage of solar energy for structural heating.

20 pts.
(Maximum)

B. Conservation of Energy, Water and Other Resources

To encourage the conservation of scarce resources, especially energy, water and recyclables. One method to receive points in the energy conservation section is by providing any number of options from the list below. There may be other ways to conserve energy and an open category is provided where an applicant can propose an energy conservation proposal not listed, carefully document the resulting energy savings, and be awarded from (1) to twenty (20) points. Points in this section will be awarded only when each proposal is incorporated into at least 75% of units within a project.

This section provides an option list where more than the maximum available number of points are listed. This is to allow greater flexibility for the applicant to receive points, since there are more categories to choose from. No more than a total of twenty (20) points will be awarded for conservation, however.

20 pts. - (1) Option List
Maximum

2 points for each of the following:

a. Orientation of streets and/or buildings to provide maximum solar access;

b. Face sloping roofs to South;

c. Guarantee solar access through sales contracts, PUD conditions or other legally binding agreements;

d. Energy efficient space and water heating equipment;

e. If multi-family, individually metered units;

f. Energy conservation owner's manual;

4 points for each of the following:

g. Increase insulation twenty percent (20%) above the City Energy Conservation and Insulation Code requirements;

h. Reduce area of non-southern glazing twenty percent (20%) below the City Energy Conservation and Insulation Code requirements;

i. Triple glazing on non-south windows;

WHEREAS, continued reliance on foreign energy sources and non-renewable fossil fuels will result in increasing energy shortages, an unstable economy, and resultant diminishment to the quality of life, health, safety, and welfare of Del Mar citizens;

WHEREAS, numerous energy studies and the projected escalation of fuel prices indicate the desirability and feasibility of rapid conversion to renewable energy resources and that passive and hybrid solar space heating systems are now cost effective;

WHEREAS, State and Federal tax incentives substantially mitigate the capital costs of solar energy installations, and the life-cycle cost advantages of solar energy systems will continue to increase as production techniques improve and conventional fuel costs continue to escalate;

WHEREAS, increased reliances upon solar energy systems will alleviate demands upon local utility purveyors to procure additional non-renewable energy resources and to construct additional fossil or nuclear fueled power plants and transmission facilities which may have serious environmental, economic, and social impacts;

WHEREAS, the Del Mar Community Plan specifically encourages energy efficient heating systems and an increased degree of energy self-sufficiency through such means as solar heating;

WHEREAS, the local climate is sufficiently mild so that the installation of conventional back-up space heating systems can be optional rather than mandatory;

WHEREAS, the California Legislature, through their adoption of the Solar Rights Act of 1978, has proclaimed that a policy of the State is to encourage the use of solar energy systems;

WHEREAS, the California Legislature, through their adoption of the Solar Shade Control Act of 1978, has proclaimed that there are certain situations in which the need for widespread use of alternative energy devices, such as solar collectors, requires specific and limited controls on trees and shrubs;

WHEREAS, for this Ordinance to be effective, private and public properties within the City of Del Mar require reasonable access to solar energy and that adjacent landscaping which substantially deprives a site of solar access constitutes a public nuisance;

WHEREAS, the intent of this Ordinance is to implement the stated policies of the Federal, State and local governments and to decrease the City's dependence on conventional fossil fuels by encouraging and mandating the use of solar energy systems for the heating of buildings and for the heating of domestic water and swimming pools.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF DEL MAR, CALIFORNIA, DOES HEREBY ORDAIN AS FOLLOWS:

1. Chapter 6 of the Del Mar Municipal Code is hereby amended by the addition of Article V to read as follows:

the collection, storage, and distribution of solar energy for space heating or cooling or for water heating.

6-71 SPACE HEATING AND COOLING OF NEW STRUCTURES

Space Heating

All new structures proposed or required to be heated shall be provided with an active, passive, or hybrid solar space heating system. The solar space heating system shall be considered acceptable if it is designed to minimize the use of conventional energy sources consistent with the stated intent of this Article. The City Council may, from time to time, adopt by Resolution, solar space heating guidelines intended to assist in the implementation of this Section. Required solar space heating systems shall at minimum meet or exceed said guidelines adopted by the City Council, or shall consist of an alternative design, which, in the opinion of the City, is sufficient to meet or exceed the stated intent of this Article.

Space Cooling

The installation of conventional air refrigeration systems shall be discouraged in all new structures. Permits for conventional air refrigeration systems when proposed, shall be at the discretion of the Design Review Board, or City Council on appeal. This Section shall not apply to rooms where air refrigeration systems are necessary, such as medical treatment rooms or rooms designed for the storage, maintenance, or processing of temperature sensitive materials or equipment.

6-72 WATER HEATING

All new structures requiring or proposing hot water shall be equipped with a solar hot water system. Said solar system shall provide the primary means of providing hot water; however, nothing in this Section is intended to preclude the installation of a conventional back-up hot water heating system capable of augmenting the solar system during periods of inclement weather. The solar hot water system shall be considered acceptable if it is designed to minimize the use of conventional energy sources consistent with the stated intent of this Article. The City Council may, from time to time, adopt by Resolution, solar hot water heating guidelines intended to assist in the implementation of this Section. Required solar hot water systems shall at minimum meet or exceed said guidelines adopted by the City Council, or shall consist of an alternative design which, in the opinion of the City, is sufficient to meet or exceed the stated intent of this Article.

6-73 SWIMMING POOL HEATING

All swimming pools proposed to be heated, or plumbed or otherwise connected to a spa or jacuzzi, shall be equipped with a solar pool heating system. Conventional swimming pool heating systems shall be prohibited, except those spas or jacuzzis whose water surface area is less than seventy-five (75) square feet may be heated by conventional means. Swimming pools which are plumbed or otherwise connected to a spa or jacuzzi utilizing conventional heaters shall include a solar swimming pool heating system which contains an unglazed solar collector area of not less than one-half of the surface area of the swimming pool, or shall consist of an alternative design, which, in the opinion of the City, is sufficient to meet or exceed the stated intent of this Article.

6-74 ENLARGEMENTS, REMODELS AND CONVERSIONS OF EXISTING STRUCTURES

Enlargement: Any structure requiring hot water, and whose floor area is increased by 25% or more of the floor area which existed prior to its enlargement shall provide for the retrofit of solar water heating throughout the entire structure pursuant to Section 6-72 of this Article, and, where feasible, shall be retrofitted with attic insulation of a value of R-19 or greater.

Board review. The plans shall contain a statement briefly describing the solar system and affirming that the system is designed to meet the requirements of this Article; said statement shall be signed by a licensed architect, registered engineer, or qualified solar consultant or solar installation contractor who is classified under Chapter 8, Title 16 of the California Administrative Code to design and install the type of solar system proposed.

Staff Review and Approval: Any application scheduled to appear on the Design Review Board consent calendar shall be reviewed by the Planning Department to determine whether or not there is compliance with this Article. Upon a finding by staff that there is compliance, no further review shall be required except as may be mandated by other sections of this Article and of the Del Mar Municipal Code. A determination by the Planning Department may be appealed to the Design Review Board within 10 days by any interested party. The Planning Department shall report its determination in writing to the applicant and Design Review Board no later than the Design Review Board consent calendar hearing date.

Design Review Board Review: Any application required by other provisions of the Del Mar Municipal Code to be heard by the Design Review Board on its regular agenda shall be concurrently reviewed by said Board for compliance with the provisions of this Article. Upon approval of the Design Review Board, no further review shall be required except as may be mandated by other sections of the Del Mar Municipal Code. A determination by the Design Review Board may be appealed to the City Council within 10 days by any interested party. Fees for appeals as provided for in this Section shall be set by Resolution of the City Council.

6-79 USE OF SOLAR SYSTEMS AND MONITORING EQUIPMENT

Each solar system installed shall include for the owner a set of operating instructions which describe how the system functions, what is expected from the system in terms of minimum service levels, and how to operate the system for maximum efficiencies. Each solar hot water storage tank shall be equipped with a thermometer to permit the owner to self-monitor the effectiveness of the system.

6-80 CONFLICT WITH OTHER MUNICIPAL POLICIES AND ORDINANCES

Nothing in this Article does, or is intended to abrogate the owner's responsibility to meet all other municipal policies and ordinances applicable to the development of real property within the City of Del Mar, including but not limited to the preservation of private and public views, the quality of architectural design, the preservation of historic landmark structures, or the like.

6-81 EXEMPTIONS

An exemption or partial exemption from the requirements of this Article may be granted by the Design Review Board upon a finding by the Board that required conformity with the requirements of this Article would constitute an unreasonable economic or physical hardship to retrofit an existing structure or swimming pool, and/or that solar access to the proposed building site is excessively limited due to terrain, adjacent structures, or adjacent landscaping which cannot, or, in the opinion of the Board, should not be abated. Pursuant to Section 25985 of the Public Resources Code, the provisions of the California Solar Shade Control Act shall be exempted for said adjacent landscaping which cannot or, in the opinion of the Board, should not be abated. Within the meaning of this Section, "excessively limited solar access" means that direct radiation to a reasonably sized and located solar collection area would likely be blocked or shadowed between the hours of 10:00a.m. and 2:00p.m. on December 21 of any year, for 10%

TITLE 27

LINCOLN MUNICIPAL CODE

ZONING

LINCOLN, NEBRASKA

AMENDED TO:

27.71.040 Construction and use of accessory buildings. No accessory buildings shall be constructed upon a lot until the construction of the main building has been commenced, and no accessory buildings shall be used for dwelling purposes. (Ord. 12571 §376; May 8, 1979).

27.71.050 Projections from buildings. Every part of any required yard shall be open to the sky, unobstructed by a building, except:

(a) Eaves may project into a front or rear yard thirty-six (36) inches, exclusive of gutters;

(b) Eaves may project into a side yard twenty-four (24) inches, or two-fifths of the required side yard, whichever projection is greater, exclusive of gutters;

(c) Ordinary projection of sills, belt courses, cornices, vertical solar screens, and ornamental features which may project twelve (12) inches; and

(d) Air conditioners, not to exceed five (5) ton units or parts thereof, may project into a required side yard, provided that such projection shall be distant at least two (2) feet from the adjacent lot line and shall not extend more than three (3) feet from the building. Such air conditioners may project into a required front yard but shall not extend more than three (3) feet from the building, and such air conditioner may extend into one side of a corner lot;

(e) Solar collectors which are a part of the main building may extend into a required rear yard for a distance not to exceed ten (10) feet;

(f) As otherwise provided in this chapter. (Ord. 12571 §377; May 8, 1979).

27.71.060 Walkways in the rear yard. In the required rear yards of the O-1, B-1, B-2, B-3, H-1, H-2, H-3, and I-1 districts, enclosed walkways not more than one (1) story in height nor eight (8) feet in width are permitted within two (2) feet of the rear lot line. (Ord. 12571 §378; May 8, 1979).

27.71.070 Occupancy of basements and cellars. No basement or cellar shall be occupied for residential purposes until the remainder of the building has been substantially completed. (Ord. 12571 §379; May 8, 1979).

27.71.080 Fences. Notwithstanding the area regulations of this title with the requirements for open space for front yard, side yard, and rear yard, fences may be erected to a height not to exceed seventy-two (72) inches on any part of a lot, provided that no fence shall be erected on a corner lot within that triangular area bounded by the property lines and a diagonal line joining points on the property lines located twenty-five (25) feet from the point of intersection of the property lines on two intersecting streets, or in the case of rounded corners, the triangular area bounded by the tangents to the curves of property lines on two intersecting streets and a diagonal line joining tangents to said curves at points that shall be located twenty-five (25) feet from the point of intersection of said tangents. The tangents referred to are those at the beginning and at the end of the curve at the corner. An open wire fence not to exceed forty-eight (48) inches in height may be located on such part of a corner lot when in the opinion of the building official the location of the same will not result in a hazard to the lawful use of the said streets. The height of a fence shall be determined by a measurement from the ground level at the lowest grade level within two (2) feet of either side of such fence.

The height limitations herein provided for fences permitted on any part of a lot, notwithstanding the area regulation of this title with the requirements for open space from front yard, side yard, and rear yard, shall not apply to fences required by the city for uses permitted by the city. It is not intended that any structure other than a fence is permitted on any part of a lot by this section, and all other structures must comply with area and use regulations of this title. (Ord. 12571 §380; May 8, 1979).

seventy-five (75) acres, and in the AGR agricultural residential district, a minimum area of ten (10) acres.

(f) A community unit plan which complies with the energy conservation standards adopted by the city council and on file with the city clerk may receive a dwelling unit bonus in accordance with the standards adopted by resolution of the city council.

(g) Additional dwelling units may be granted by the city council for each dwelling unit subsidized by the state or federal government for low-income families or as a dwelling unit bonus for the provision of barrier-free units; however, the number of additional dwelling units shall not exceed those provided in the standards adopted by resolution of the city council.

(h) A community unit plan located in the AG or AGR zoning districts which will protect the open space areas as designated in the future land use maps of the Lincoln City-Lancaster County Comprehensive Plan may receive a dwelling unit bonus in accordance with the standards adopted by resolution of the city council. A similar dwelling unit bonus may be made for protection of environmentally sensitive areas not shown in the plan. However, any such request shall be accompanied by a showing by the applicant of the need and means for protection of a portion of the property.

(i) The dwelling unit bonuses permitted under this section shall not exceed a total of twenty percent (20%) in any community unit plan. (Ord. 12571 §345; May 8, 1979).

27.65.025 Permitted density; not transferrable to AG or AGR zoning districts. The permitted dwelling unit densities of land zoned R-1, R-2, R-3, R-4, R-5, R-6, R-7, R-8, O-1, O-2, O-3, B-1, B-2, B-3, B-4, and B-5 shall not be transferred for the purpose of construction and occupancy of dwelling units to land located in the AG or AGR zoning districts. (Ord. 12768 §1; November 19, 1979).

27.65.030 Procedures. An application and plot plan and plans for development of a community unit plan under this chapter shall be filed in writing with the codes administration division. Upon the filing of an application, together with all information required by this chapter, the city council will refer the application to the planning commission. The planning commission shall hold a public hearing upon such application and make a report to the city council regarding the effect of the proposed use upon the surrounding neighborhood, the community as a whole, and other matters relating to the public health, safety, and general welfare. The city council shall take no final action upon any application for a community unit plan filed under this chapter until a report from the planning commission has been filed with the city clerk; provided, that in the event there is a delay in excess of sixty (60) days from the date of referral on the part of the planning commission in reporting its recommendations to the city council, the applicant may appeal to the city council requesting final action. If the city council determines that the delay of the planning commission is unjustified, it shall direct the commission to submit a report no later than immediately after the commission's next regularly scheduled meeting.

The report of the planning commission to the city council shall include reasons for recommending approval or denial of any application and if approval is recommended, shall further include specific evidence and facts showing that the proposed community unit plan meets the following conditions:

(a) That the land surrounding the tracts for the proposed community unit plan will not be adversely affected;

(b) That the proposed community unit plan is consistent with the intent and purpose of this title to promote the public health, safety, and general welfare;

(c) That the buildings and land in the proposed community unit plan shall be used only for single-family dwellings, two-family dwellings, townhouses, or multiple

MIDDLEBURY, CONNECTICUT

Amendments of Subdivision Regulations (Solar Access)

Adopted 10/16/80 Effective 10/18/80

SECTION 1.0 - GENERAL PROVISIONS

A. Add four new subparagraphs to Section 1.6 Definitions to define solar access, solar collector, passive solar energy system, and building orientation, as follows:

"1.6.3 Solar Access: The term 'solar access' is defined as the ability to allow sunlight to strike a solar collector. The best period for evaluating solar access is between the hours of 10:00 a.m. to 2:00 p.m. on December 21."

"1.6.4 Solar Collector: The term 'solar collector' refers to any device or area that uses the sun's energy to heat domestic water or to heat, cool or light a living space."

"1.6.5 Passive Solar Energy System: The term 'Passive Solar Energy System' refers to a solar energy system where the collector and thermal storage components are integrated, requiring no transfer device for solar-heated fluid and usually being an essential architectural component of the building."

"1.6.6 Building Orientation: The term 'Building Orientation' refers to the relationship of a building's longest axis to the true south compass point. Optimal building orientation occurs when the building's longest axis is east to west (90° from true south) with acceptable variations of 15° north of due east (or 15° south of due west) to 15° south of due east (or 15° north of due west)."

SECTION 2.0 - APPLICATION REQUIREMENTS AND PROCEDURE

B. Add a new subsection to Section 2.3 Formal Application Requirements to enable the Planning Commission to ask for additional information to guarantee that solar energy requirements have been taken into account in the planning and design of the subdivision as follows:

"3.2.21 <u>the limits of any areas of tree removal necessary to provide effective use of a passive solar energy system and the identification of predominant tree types in those areas."</u>

SECTION 4 - DESIGN AND CONSTRUCTION STANDARDS

E. Amend Section 4.3 <u>Building Lots</u> to require that the planning and design of a subdivision take into account existing vegetation which serves energy conservation purposes as follows:

"4.3 <u>Building Lots</u>: Proposed building lots shall be of such shape, size, location, topography and character that buildings can be constructed reasonably and that they can be occupied and used for building purposes without danger to the health and safety of the occupants and the public. Any lot which is found to be unsuitable for occupancy and building by reason of water or flooding conditions, unsuitable soil, topography, ledge rock or other conditions shall be combined with another contiguous lot that is suitable or shall be marked, "This is not an approved lot" on the subdivision map, until necessary improvements to the lot have been made and approved by the Commission and a revised subdivision map has been submitted to and approved by the Commission. Proposed building lots shall be designed and arranged to make best use of the natural terrain, avoiding unnecessary regrading, and to preserve substantial trees, woods <u>and other vegetation, particularly those existing plant materials to the north of proposed house locations which serve as wind barriers and aid energy conservation. Other effective wind barriers may be included, such as earth mounds."</u>

F. Amend subsection 4.3.3 <u>Lot Lines</u> of Section 4.3 <u>Building Lots</u> to permit lot lines to take into account orientation to the sun as follows:

"4.3.3 <u>Lot Lines</u>: Insofar as practicable, the side lot lines of all lots shall be at right angles or radial to the street on which the lot faces, or shall be radial to the street line, <u>unless the purpose of lot line orientations, other than those mentioned, is to secure greater solar access or protection or control thereof. It shall be within</u> the discretion of the Commission to refuse to permit municipal boundary lines to cross any lot, and in the event of such refusal, such boundary line shall be made to constitute one of the lot lines."

H. Amend Section 4.14 entitled Parks and Recreation Areas to change its caption to "Open Spaces, Parks and Recreation Areas" and to require that the location of proposed open spaces take into account the extent of solar access provided each proposed lot in the subdivision as follows:

"4.14 Open Spaces, Parks and Recreation Areas: Land for parks, playgrounds, recreation areas and open spaces shall be provided and reserved in each subdivision as deemed necessary and in locations deemed proper by the Commission. The land reserved shall be of such size, location, shape, topography and general character as to be useful to satisfy the needs determined by the Commission. Proper pedestrian and vehicular access shall be provided each such reservation. The reservation of land shall also conform to any plan of development pertaining to parks, playgrounds, recreation areas and open spaces. In determining the need for provision of land for parks, playgrounds, recreation areas and open spaces, the Commission shall be guided by, but not limited to, a standard of 1,000 square feet of land area for each building lot and a minimum reservation area of one acre, and shall take into consideration the size of the subdivision and any existing parks, playgrounds, recreation areas and open spaces in the neighborhood. If the Commission determines that land so reserved shall be used for open space rather than park or playground purposes, the location of such land shall take into account the solar access requirements of the entire subdivision as deemed necessary by the Commission as follows:

a. if the maximum possible number of lots have good solar access as determined by the Commission under Section 4.16, land for open space reservation should be located in such a manner as to avoid the creation of lots without good solar access.

b. if the tract of land is such that few lots can be provided with good solar access, land for open space reservation should, whenever possible, be located on a portion of the tract which does have good solar access in order to provide for future use of community solar energy systems."

K. Amend subsection 3.2.8 under Section 3.2 entitled <u>Site Development Plan</u> to require location of proposed structures, as follows:

"3.2.8 existing <u>and proposed</u> permanent buildings and structures."

L. Amend subsection 3.2.17 under Section 3.2 to require at least <u>two (2)</u> test pits per lot.

ORDINANCE NO.________

AN ORDINANCE AMENDING CHAPTER 19 (SUBDIVISIONS) OF THE CODE OF ORDINANCES, CITY OF PORT ARTHUR, TEXAS, TO ADD CONSERVATION OF ENERGY; DEFINITION OF SOLAR ENERGY; DESIGN OF STREETS; AND PAVED STREETS WITH OPEN DITCH DRAINAGE; PROVIDING A PENALTY OF NOT LESS THAN ONE DOLLAR NOR MORE THAN TWO HUNDRED DOLLARS FOR ITS VIOLATION; AND PROVIDING FOR PUBLICATION IN THE OFFICIAL NEWSPAPER OF THE CITY OF PORT ARTHUR.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF PORT ARTHUR:

Section 1. That Section 19-3 (Purpose) of Article I (General Provisions and Requirements) of Chapter 19 (Subdivisions) shall be amended to read as follows:

"Sec. 19-3. Purpose.

"To provide for the safe, orderly, and healthful development of the City and its environs; for the coordination of streets within subdivisions with other existing or planned streets, or with other features of the comprehensive plan and major street and highway plan of the City; for access to and extension of public utility facilities; for the conservation of energy; for adequate open space for traffic, recreation, light, air, and utilization of solar energy; and for the distribution of population and traffic which will tend to create conditions favorable to health, safety, morals and the general welfare of the City."

Section 2. That Section 19-5 (Definitions) of said Chapter and Code shall be amended by adding Section (35), which shall read as follows:

"(35) Solar Energy: Radiant energy (direct, diffuse, and reflected) received from the sun."

Section 3. That Subsections (a) (General Principles of Acceptability), (E) (Public Sites and Open Spaces), (F) (Streets and Alleys), (H) (Engineering Data), and (I) (Lots) of Section 19-33 of said Chapter and Code shall be amended as follows:

A. Paragraph (3) of Subsection (A) of Section 19-33 shall read as follows:

"(3). Subdivisions shall fit and take advantage of topography and solar orientation to the end that good building sites are provided and utilities can be provided most economically."

"The following note for side lot lines may be used when applicable in lieu of bearings:"

F. That Paragraph (1) (General) of Subsection (I) (Lots) shall be amended to read as follows:

"(1) General. The lot design shall provide for lots of adequate width, depth, and shape for solar orientation, to provide open area, to eliminate overcrowding, and to be appropriate for the location of the subdivision and for the type of development contemplated. Lots and building setback lines shall be designed so that at least eighty (80%) percent of the buildings in the subdivision can be oriented with their long axes parallel to nine (9°) degrees south of West with a possible variation to six (6°) degrees north of West or to twenty-five (25°) degrees south of West. Exceptions to the required orientation may be granted as provided in Section 3,f,(1),(b) hereof. All lots shall front on a street except as may be excepted by the provisions of the 'Townhouse and 'Townhome' Ordinances (Ordinances No's. 68-33 and 68-34 respectively)."

Section 4. Subsection (A) of Section 19-42 shall be amended by the addition of the following paragraph, which shall read as follows:

"In or adjacent to a previously platted and improved subdivision where the storm drainage is predominantly of open-ditch design, the Commission may approve, upon the recommendation of the City Engineer, a concrete street pavement width of twenty-two (22) feet to twenty-four (24) feet with open-ditch drainage."

Section 5. The above provisions are to be inserted in the affected Code of Ordinances, City of Port Arthur, Texas, in the sequence required by their designation.

Section 6. If any section, subsection, sentence, clause, phrase, or portion of this Ordinance is for any reason held invalid or unconstitutional by any court of competent jurisdiction, such portion shall be deemed a separate, distinct, and independent provision and such holding shall not affect the validity of the remaining portions hereof.

Section 7. All Ordinances and parts of Ordinances in conflict herewith are hereby repealed, but only to the extent of such conflict.

Section 8. Any person who violates any provision of this Ordinance or who shall neglect to comply with the terms hereof shall be deemed guilty of a misdemeanor, and shall on conviction thereof be fined

PORTLAND, OREGON

ORDINANCE NO. 148251

An Ordinance adopting an Energy Conservation Policy for Portland.

The City of Portland ordains:

Section 1. The Council finds:

1. That Resolution No. 31911 directed the formation of the Energy Policy Steering Committee (Committee) and that Resolution No. 32032 appointed the membership of that Committee.

2. That the Committee was charged with examining the findings of the Portland Energy Conservation Project and based upon the technical feasibility of certain conservation measures, their social and economic impact and their potential to save conventional energy resources, with developing for Council consideration a comprehensive energy conservation policy for Portland.

3. That the Committee and its technical task forces were remarkably diligent, volunteering over 3,500 hours of work to develop the Proposed Policy, the result of which is a model plan for conserving energy within this or any other municipality.

4. That in certain cases, the Proposed Policy recommends actions that, in fact, are already being carried out by the City government in order to conserve energy. These include life cycle costing purchasing arrangements, the set-aside of City funds to implement conservation measures and other actions previously authorized by Council in Ordinance No. 145413 which accepted the policy and procedure recommendations of the City Energy Management Task Force, a standing internal committee of City government.

5. That the City, state, nation, and world face drastic energy price increases in the short run and energy scarcity in the long run; that these problems have a direct local impact on the health, safety, and welfare of the citizens of Portland; and that it is possible through local action to contribute to the resolution of these problems. Increased energy costs reduce the amount of money available to citizens to pay for the other

Increase the energy efficiency of existing structures and the transportation system of the City through policies and programs which encourage conservation of nonrenewable energy resources, while maintaining the attractiveness of the City as a place to live and do business.

In order to accomplish this goal the following six policies and their objectives are adopted as the Energy Conservation Policy (Policy) of the City of Portland.

b. Policy #1 shall be:

THE ROLE OF THE CITY IN ENERGY CONSERVATION

The role of the City is to ensure the accomplishment of the Goal. All of the energy policies are to be policies of the City and depend on City action. The City shall implement conservation actions directly within City government and encourage conservation actions by the private sector. This shall be accomplished through education, incentives, and mandatory actions. The City's efforts shall include promoting conservation; informing all sectors of available programs and conservation techniques; developing financial incentives; advocating the support of the City efforts at the state, regional, and federal levels; and regulating conservation actions where appropriate. The City shall evaluate indicators of energy consumption to assure the effectiveness, comprehensiveness and fairness of private sector actions.

The objectives of Policy #1 are:

(1) To assure proper review and evaluation of the Policy by a nine-member Energy Commission (Commission) comprised of citizen representatives appointed by the Mayor and confirmed by the Council, which will advocate conservation actions, monitor the progress of implementation, and propose to the Council changes in the Policy as appropriate. The Commission will make periodic reports to the Council on its activities and will issue an in-depth analysis of Policy implementation activities and Policy effects not later than three years from the enactment of this Ordinance, again not later than five years from the enactment of this Ordinance, and at least every three years thereafter.

(2) To assure proper City support for the Policy and the Commission by establishing a City Energy Office within the Office of Planning and Development which will provide staff support for the Commission, shall evaluate the Policy implementation, admini and monitor City government conservation activities, review C policies and programs for consistency with the Policy and make recommendations to the Council on the policies and programs, and accomplish other functions as required or directed by the Administrator of the Office of Planning and Development, the Commissioner-in-Charge or the City Council.

(3) To assist residential property owners to reach a zero net outflow of capital expended for energy conservation actions through a range of financial and tax incentives.

The goal of this directive is to enable conservation actions to be taken which result in owners paying no more for their combined monthly fuel bill plus the weatherization costs than they paid previously for fuel alone. Such monthly costs would be averaged over any year, would assume no increase in average monthly consumption for the monthly average of the first year after the actions are taken and would be calculated in constant dollars.

The needs of renters will be satisfied by stimulating owner investment through these and other incentives which reflect the unique character of investor-owned residential properties.

(4) To provide financing for measures not covered by existing programs through establishment of a loan pool in cooperation with private lenders which could be used for conservation loans where no other financing mechanisms are applicable.

(5) To facilitate the choice of financing options so that property owners can maximize their financial benefits.

(6) To achieve the retrofit of 15% of the City's housing units annually through voluntary actions which are cost-effective and satisfy the recommendations of the energy audit.

(7) To achieve the eventual compliance of 100% of the City's housing units by requiring the cost-effective retrofit of all residences in the city beginning five years from the enactment of this ordinance. The requirement will be enforced at the point of sale of the building and will include both owner-occupied and investor-owned properties.

Further, in the case of structures containing rental housing the retrofit requirement may also be enforced at the point of unit turnover.

The Commission shall recommend to Council new or amended City code provisions and administrative rules, including any authorized exceptions, to carry out this Policy.

c.ii. The Non-Residential objectives are:

(1) To encourage reduced energy consumption in non-residential buildings and in industrial processes through a program of energy audits and energy plans which identify retrofit actions and industrial process modifications and mechanical system efficiencies. Undertaking of audits and development of plans will be mandatory beginning five years from the enactment of this ordinance.

(2) To facilitate the accomplishment of such energy audits and conservation plans by directing that PECI develop standard procedure and methodology for performing and certifying the energy audit. In addition, PECI shall provide, or assist in providing or arranging for the technical personnel and financial resources necessary to accomplish such audits and plans as requested by Portland residents and businesses. The preferred method of accomplishing this activity is through private sector firms working in cooperation and coordination with PECI.

(3) To reduce the energy consumption in non-residential buildings by requiring that cost-effective retrofits be undertaken by the building owner when the building is sold or when remodeling equal to 50% of the replacement value of the building is undertaken, beginning five years from the date of the adoption of this ordinance. Industrial processes are exempt.

(4) To encourage the voluntary achievement of the energy conservation goal in non-residential structures and industrial processes by establishing programs to market energy conservation through educational and information forums, media presentations and other techniques.

(5) To obtain tax incentives for process industries by encouraging the adoption of state and federal legislation providing for accelerated depreciation of energy inefficient equipment and investment tax credits to offset the costs of energy conservation actions; including audits and engineering reports, retrofit, and process modification.

(6) To assist industry to obtain the capital required for investment in improved process and mechancial systems efficiencies, alternative energy systems, and other major conservation actions through loans made available from the sale of municipal bonds, such as industrial revenue bonds. This applies especially to small businesses with problems of capital accumulation.

(1) To promote patterns of land use which decrease consumption of fuel for transportation and space heating by making energy conservation a critical element in land use decisions by the City.

(2) To reduce the need to travel by promoting a density, location and mix of land uses which would tend to decrease the length of required daily trips and encourage the consolidation of related trips.

(3) To increase access to transit by promoting medium to high density residential, employment intensive commercial, and retail commercial development near proposed transit stations, and medium density residential development along major transit streets.

(4) To reduce energy consumed for space heating residential buildings by promoting the construction and renovation of attached single and multi-family dwelling units.

(5) To increase the economic feasibility of close-in urban housing.

(6) To carry out the above objectives, the Council finds that the the following land use actions will provide sound and effective means to fulfill the energy conservation objectives and instructs the Portland Planning Commission to consider these, as well as other energy conserving measures, in development of the Comprehensive Plan and in considering other land use decisions brought before the Commission. The Council further directs that when the Commission finds that it is not appropriate to apply these recommended actions to specific properties or situations of the Plan or to other land use decisions, the Commission shall note in its report to Council the proposed exception to this Policy and shall summarize the issues in an understandable and meaningful manner. The actions include:

(a) Development of downtown, regional and neighborhood service commercial centers with a balance of complementary retail and employment activities.

(b) Consolidation of neighborhood retail, office and community service establishments in neighborhood service centers located on major transit and arterial streets.

(c) Development of medium and high-density residential zones in and adjacent to the downtown core and other general commercial centers and development of medium-density residential zones adjacent to neighborhood service centers.

(d) Development of housing adjacent to employment areas.

tect/engineer and the building owner certify that such application was evaluated during the preliminary (schematic) design phase of the project.

(6) To promote the proper use of the technology by including technical information on solar and alternative energy sources in the City's energy conservation marketing program.

(7) To expand the financial resources available for solar and alternative energy applications by including such measures in the financial and tax incentive programs called for in this Policy.

(8) To recapture energy which would otherwise be lost in the traditional methods of solid waste disposal by requiring all refuse collectors doing business in the City to provide a recycling option to their customers as a condition of obtaining a City business license issued after July 1, 1980. This requirement will apply only to those materials which are cost-effective to recycle. Such a recycling option would have to be provided at no additional cost to the consumer.

(9) To encourage voluntary recycling of other solid waste and motor oil through a program of education and promotion and the siting of private recycling depots throughout the City and at landfill sites.

(10) To encourage, if necessary, recycling activities by initiating City economic development efforts to foster an adequate number of secondary material handlers to market the recycled "waste".

f. Policy #5 shall be:

TRANSPORTATION

The consumption of nonrenewable fuels for transportation shall be reduced through actions which increase the efficiency of the transportation system operating within the City. These actions will encourage individuals to choose the method of travel which is the most fuel-efficient for the purpose of the trip; promote the energy-efficient movement of goods; and provide incentives for the use of fuel-efficient vehicles.

The objectives of Policy #5 are:

(1) To improve the operations and service delivery capability of transit system by: (a) carrying out projects which speed and smooth the flow of traffic; (b) reducing peak hour transit and transportation demand by encouraging employers to institute staggered work hours; (c) evaluating the system and its routes for energy efficiency and including this information in the decision criteria for system changes; (d) lobbying for changes in federal rules and regulations which cause inefficiency in

owners in having indicated adjustments or repairs made, and by providing owners with a report describing potential energy savings attainable from simple maintenance actions.

g. Policy #6 shall be:

CITY GOVERNMENT

City bureaus shall reduce energy consumption by investing in energy conservation opportunities and changing operational procedures to the most energy- and cost-effective extent possible.

The objectives of Policy #6 are:

(1) To reduce overall City government energy use by abiding by the policies and objectives contained in the Energy Policy which are applicable to City government.

(2) To procure the most energy-efficient goods, equipment and buildings through full implementation of the life cycle costing procedure.

(3) To reduce work-related local travel by City employees by 10% in comparison to the base year travel pattern through monitoring and reporting systems.

(4) To increase the energy efficiency of all City-owned buildings by establishing and carrying out a set of standard operating procedures to reduce energy use in mechanical and operational functions.

(5) To reduce energy use in the solid waste disposal system by (a) changing the collection process to eliminate overlapping service area allocation; (b) efficient route management; (c) construction of transfer stations to reduce trip length for small operators; and (d) the Metropolitan Service District establishing working arrangements with private firms capable of capturing the energy generation potential of solid waste.

(6) To reduce the energy used by City employees in their journey to work by requiring all new City employees, and existing employees who change their domicile, to reside within the City. This directive will be carried out by proposing a City Charter amendment at the next general election.

(7) To reduce energy use for street lighting by continuing the systematic shift from mercury vapor and incandescent street lights to more efficient high pressure sodium vapor fixtures.

(8) To manage City government energy use more effectively by establishing and maintaining an accounting system to track City energy consumption and costs in order to identify conservation opportunities.

ORDINANCE NO. 148252

An Ordinance directing City bureaus, offices, commissions and employees to initiate and undertake actions which begin the implementation of the Energy Conservation Policy.

The City of Portland ordains:

Section 1. The Council finds:

1. That an Ordinance was passed by Council adopting an Energy Conservation Policy for Portland.

2. That in order to begin to implement the Policy, City bureaus, offices, commissions and employees must undertake certain actions and develop certain administrative procedures.

NOW, THEREFORE, the Council directs:

a. The Office of Planning and Development shall prepare and file not later than October 5, 1979 an ordinance establishing the City of Portland Energy Commission, the nine members of which shall be appointed by the Mayor and confirmed by the Council.

   The specific duties of the Commission shall be contained in the ordinance. The specific membership of the Commission shall be contained in a companion resolution.

   The charge to the Energy Commission shall include the following:

   1) Investigate and recommend to the Council not later than August 1, 1980, a policy on the banning of the use of electricity for space and water heating purposes.

   2) Investigate and recommend to the Council not later than August 1, 1980, a policy on the use of utility rate structures for conservation purposes.

b. The Office of Planning and Development shall prepare for filing not later than September 7, 1979, an ordinance or ordinances creating a City Energy Office as an RU within the Office of Planning and Development. The Energy Office shall be headed by the City's Energy Advisor and shall have adequate staff as determined by the City Council [illegible] out the Policy and directives of this ordinance. The ordinance [illegible] nances shall establish the duties of the Energy Office and the budget necessary as determined by the City Council to accomplish its duties.

c. The City Energy Office, working in cooperation with the City Attorney, shall prepare and file an ordinance not later than October 5, 1979, directing the establishment

The documents and ordinances creating PECI shall include the following:

1) The Board of Directors shall be appointed from among the membership of the Energy Commission.

2) Administrative procedures necessary to the mission of PECI shall be established by the Energy Commission and approved by the City Council.

3) The Board of Directors shall appoint such advisory committees as are necessary to establish and carry out the mission of the corporation. The membership of such committees shall, in the main, include those agencies, individuals and firms which will be most affected by the specific rules and regulations being developed.

e. The Energy Office, in cooperation with the Portland Development Commission, other city bureaus and private sector interests, shall develop a marketing program which point out the benefits of the Policy to people living and doing business in the city. The marketing program should appear in the work program and budget submissions of the appropriate agencies for FY 1980-81 or sooner if outside funds can be secured for its support.

f. The Energy Office shall work with government and private sector organizations to develop and secure outside funds necessary to carry out the city marketing program and the implementation of the Policy. All funds which go to the support of the Energy Office, the Energy Commission or the Portland Energy Conservation, Inc. shall be appropriated by the Council and the steps necessary to securing such funds shall follow normal, established city grant application and budget procedures.

g. The Energy Office, the Bureau of Buildings and the City Attorney shall cooperate to develop the code provisions, legislation, administrative procedure and agreements with other public bodies necessary to establish the mandatory retrofit requirements described in the ordinance adopting the Energy Conservation Policy.

h. That the Energy Office, the Bureau of Buildings, the Office of Public Works, the Bureau of Planning, and the City Attorney shall cooperate to review the city code and the city adopted Oregon Revised Uniform Building Code in order to draft appropriate legislation or amendments to allow the imposition of specific standards for building related equipment and construction methods which will reduce the consumption of non-renewable energy resources. Such standards may also apply to the siting, landscaping, and orientation of housing located in new subdivisions or planned unit developments. Such standards shall be reviewed by the Energy Commission prior to submission to Council.

directive may be satisfied by including within the Comprehensive Plan measures which accomplish this objective.

q. The Energy Office shall work with the City Attorney and other appropriate bureaus to amend current regulations in order to allow Local Improvement Districts to be formed to finance local energy systems which take advantage of solar applications or waste heat recovery systems. Such procedures should allow for partnerships between fi with waste heat recovery potential and other firms or individuals which can utilize such waste heat. The procedures also should allow for siting and construction of solar devices capable of providing common benefit to a community, whether that community be residential or business in nature or of mixed use.

r. The Bureau of Buildings shall develop administrative procedures which will ensure that the use of solar energy is analyzed and considered as an alternative to conventional heating, cooling and ventilating (mechanical) systems during the preliminary (schematic) design phase of any building project where a registered architect or engineer is currently required by state or city code. This provision may be satisfied by a self-certification process where the building owner and the architect/engineer warrant that both systems were given equal consideration.

s. The Bureau of Economic Development shall investigate the need to foster an adequate supply of secondary material handlers to market recycled "waste".

t. The Energy Office and the City Attorney shall work with the Metropolitan Service District and the various counties within the District to draft and support legislation to enable the assessment and collection of a one cent tax per gallon of gasoline and diesel fuel sold at the wholesale level in the District. The proceeds shall be used in accord with the Energy Conservation Policy.

u. The Bureau of Traffic Engineering and the Bureau of Planning shall cooperate in developing specific projects to carry out Policy 5, Objective 2 of the Policy.

v. The Bureau of Planning and the Bureau of Traffic Engineering shall work with Tri-Met to establish on-going programs to carry out Policy 5,Objective numbers 1, 3, 4, 5 and 6 of the Policy, and shall include School District No. 1 in establishing the program to carry out Policy 5, Objective 6.

w. The Bureau of Parks shall include within its FY 1980-81 work progra... and budget submission a strategy for implementing Objective 7 of Policy 5 of the Energy Conservation Policy.

CITY OF SACRAMENTO, CALIFORNIA

ORDINANCE NO. 4341 FOURTH SERIES

ORDINANCE AMENDING CHAPTER 9 OF THE SACRAMENTO CITY CODE ADOPTING REQUIREMENTS FOR ACTIVE SOLAR HEATING SYSTEMS FOR OUTSIDE SWIMMING POOLS

SECTION 1.

The City Council of the City of Sacramento hereby finds as follow

a. The residents of the City of Sacramento face the uncerta of conventional energy source supply and the certainty of rapid cost increases for conventional energy sources as a result of conventional energy resource scarcity and the lack of new production and generation facilities. Fossil fuel swimming pool heatir is a nonessential use of these scarce energy resources.

b. The California Energy Commission and California Public Utilities Commission have determined that solar water heating systems and passive design applications are technically mature ar are ready for commercial applications. Both Commissions have concluded that they should designate solar energy, along with conservation, as a preferred element of supply planning to meet California's future energy needs.

c. Studies have been conducted which show the local climat conditions within the City of Sacramento are favorable to the us of swimming pools without fossil fuel heating between May and October.

d. A solar heater requirement for swimming pools will rest in a diminution in energy use greater than that which would occt

(b) The term "swimming pool" shall mean and include any confined body of water exceeding two (2) feet in depth and greater than one hundred fifty (150) square feet in surface area, located above or below the finished grade of the site, and designed, u or intended to be used, for swimming, bathing, or therapeutic purposes. The term "swimming pool" as used in this section shall not include any swimming pool fully enclosed in a permanent structure or apply to a hot tub or spa which is not installed with a swimming pool.

(c) The term "active solar system" as applied in this section shall mean and include a device which circulates water through a heat exchange device ("collector") for the purpose of heating water for a swimming pool by use of radiated solar energy; and,

(i) which has a collector surface area equal to at least fifty percent (50%) of the surface area of the swimming pool; and,

(ii) which complies with the then current regulations of the California Energy Commission with respect to orientation of collectors for water heating systems for swimming pools (currently California Administrative Code, Title 20 Section 2603(b)).

(d) Any active solar system for which the person instal' the system obtains a CAL SEAL label pursuant to the CAL SEAL program shall be deemed to conform to the requirements for an active solar system stated above. Any active solar system which meets the Regulations for the California Solar Tax Credit establish

SALEM, OREGON

Department of Energy

LABOR & INDUSTRIES BUILDING, ROOM 102, SALEM, OREGON 97310 PHONE 378-4040

May 11, 1981

Dear Solar Access Enthusiast:

Attached is a copy of the model Solar Access Recordation Ordinance prepared for the City of Woodburn, as per your request. This model supercedes the ordinance actually adopted by Woodburn, although substantively it is the same. It was prepared by Henry S. Markus with input from planners, attorneys, architects and developers. We are presently encouraging Oregon cities and counties to consider adoption of this ordinance.

The accompanying report presently is unavailable. Briefly the ordinance works this way. Homeowners and businesses may apply to the City for their solar access to be recorded and guaranteed, documenting the sunlight available to the collector with a sunchart. To ensure maximum cost-effective use of conservation and solar and to minimize the burden on neighbors, the ordinance presribes standards that the applicants system must meet to have their appliction approved. This includes proper weatherization of the building as determined by an energy audit; a showing of how the applicant has done everything reasonable to design and site the collector so as to minimize the impact on neighbors; and a determination of cost-effectiveness of the system, based on net present value.
also includes minimum energy contribution standard.

If the standards are met, restrictions are placed on new construction and vegetation. Trees are prohibited from shading the collector during solar heating hours as determined from the sunchart. Woodburn will permit new construction that meets the City's development standards; the applicant must draw such hypothetical buildings onto the sunchart, and would be granted access only beyond that level, avoiding the issue of spot-zoning or taking. However, the planning director is to recommend amendments to development standards to be consistent with the goal set out in the ordinance of providing and protecting solar access to the south wall of buildings from 9 am - 3 pm on December 21 to the extent feasible considering, among other things, existing development and planned uses and densities. Buildings and trees that shade the collector at time of application are exempt from controls.

Section 3 Definitions

As used in this Ordinance, the following definitions, and their derivatives, shall apply:

(a) "City." The City of **(9) **, Oregon.

(b) "Collector surface." Any part of a solar collector that transmits incident solar radiation for passive solar space heating or absorbs incident solar radiation for use in the collector's energy transformation. It does not include such items as frames, supports, and mounting hardware.

(c) "Cost-effective." A solar collector or energy conservation measure is cost-effective when its net present value is greater than or equal to zero.

(d) "Development permit." Any permit or authorization issued by the City as a prerequisite for undertaking any development. It includes permits and authorizations customarily known as building permits, zoning or rezoning permits, variances, special permits, plat approvals, or subdivision or large-scale development permits.

(e) "Energy Audit." The on-site analysis, computation and written results thereof for an existing structure to determine which solar or energy conservation measures or both are applicable, their estimated installation cost, and estimated energy and cost savings if such measures are installed.

(f) "Exemption." Existing and potential obstructions as shown on a sun chart prepared as set forth in Section 6 are exempt from the effects of solar access recordation as set forth in Section 10.

(g) "Incident solar radiation." Solar energy falling upon a given surface area.

(h) "Minimum solar collector energy contribution standards." The minimum for solar domestic or pool water heating shall be 50 percent and for solar space heating 20 percent during solar heating hours. The **(10) governing body** shall approve the minimums for other particular uses.

(i) "Passive solar space heating." Heating of the interior of a structure by a direct, indirect or isolated gain system consisting of glazing and thermal mass which stores energy overnight and releases energy within the structure by radiation, conduction and/or natural convection.

(9) An explanation of how to prepare a solar envelope for a deed covenant or to satisfy a building placement, height, bulk and orientation solar performanca standard.

(10) Information on current state and federal solar incentives including tax credits and low interest loans as well as the availability of energy conservation and solar audits.

(o) "Solar access recordation." A recordation approved under the procedures and standards set out in this Ordinance.

(p) "Solar collector." A device, or combination of devices, structures, or part of a device or structure that uses incident solar radiation for passive solar space heating or that transforms incident solar radiation into thermal, mechanical, chemical, or electrical energy and that provides sufficient energy to satisfy the applicable City mimimum standard.

(q) "Solar envelope." A three-dimensional space over a lot representing height restrictions designed to protect access to sunlight for neighboring lots.

(r) "Solar heating hours."

(1) Annual. Use of solar collector during those hours between **(13) 3?** hours before and **(14) 3?** hours after the sun is at its highest point above the horizon each day year round.

(2) Summer. Use of solar collector during those hours between **(15) 4?** hours before and **(16) 4?** hours after the sun is at its highest point above the horizon each day from March 21 through September 20.

(3) Winter. Use of solar collector during those hours between **(17) 3?** hours before and **(18) 3?** hours after the sun is at its highest point above the horizon each day from September 21 through March 20.

(4) In the case of any amendment to the solar heating hours, the solar heating hours as defined on the date of issue of the solar access recordation shall apply. A recorded owner may apply for a new recordation granting the new hours of protection if longer solar heating hours are promulgated.

(s) "Sun chart." A drawing plotting the position of the sun in the sky using as coordinates solar altitude in ten degree increments and solar azimuth measured to the east and west of true south in fifteen degree increments. The sun chart shall display the path of the sun

(b) The **(22)planning commission** is directed to make a recommendation on the amendments to land development standards with **(23) 6 mo?** following adoption of this Ordinance. The amendments shall be submitted to the **(24)governing body** for review. Upon final adoption, denial or modification of such recommendation by the **(25)governing body** or **(26) 1 year** after adoption of this Ordinance, whichever occurs first, applications for solar access recordation may be made as set forth in Section 6.

Section 6 Application for Recordation of Solar Access

(a) Any property owner or registered lessee, or agent of either, may apply for a solar access recordation from the **(27)planning director**.

(b) The application shall be in such form as the **(28)planning director** may prescribe in the Solar Access Data Handbook, but shall, at a minimum, include the following:

(1) The fee established by the **(29)governing body**. (Sufficient to pay the average cost of a solar access recordation including but not limited to staff time, mailing expenses, and the fee to file the recordation with the County Clerk).

(2) The applicant's name and address, and the owner's name, address, and the **(30) customary legal designation** of the property where the collector is located.

(3) A statement by the applicant that the collector is already installed or that it will be installed on the property within **(31) 1 year** following the granting of the recordation.

(4) The size and location of the collector surface, its orientation with respect to true south, and its slope from the horizontal, shown clearly in drawing from.

(5) An explanation of how the applicant has done everything reasonable, taking cost into account, in designing and locating the collector surface in a manner to minimize the impact the solar access recordation will have on the development of nearby properties.

(6) A sun chart showing the plotted skyline from the center of the lower edge of the location of the collector surface during proposed solar heating hours. The skyline shown on the sun chart shall outline hills and existing buildings, deciduous and evergreen trees as well as potential development allowed by the City comprehensive plan, zoning ordinance and development standards applicable at time of recordation. Such existing and

(2) If the application does satisfy the requirements of Section 6, the **(40) planning director** shall accept the application and notify the applicant.

(b) Upon acceptance of an application, the **(41) planning director** shall send notice by certified letter, return receipt requested, to each owner and registered lessee of property proposed to be subject to the solar access recordation. The letter shall contain, at a minimum, the following information: an explanation of the purpose and effects of solar access recordation; the name and address of the applicant; that an application for a solar access recordation has been filed; copies of the collector location drawing, sun chart and parcel map submitted by the applicant; that the recordation, if granted, may impose on them duties to trim some vegetation at their expense; the advisability of obtaining photographic proof of the existence of trees and large shrubs; the times and places where the application may be viewed; telephone number and address of a City department that will provide further information; and that any affected person may object to the issuance of the recordation by a stated time and date, and how and where the objection must be made.

(c) If no objections are filed within **(42) 30?** days following the date that all certified letters have been mailed, the **(43) planning director** shall issue the solar access recordation.

(d) If any affected person or governmental unit files a written objection with the **(44) planning director** within the specified time, and if the objections still exist after a prehearing conference between the objector, appropriate city staff, and the applicant, then a hearing date shall be set and a public hearing held in accordance with the provisions of Section 8.

Section 8 Hearing Procedure

(a) The **(45) planning director** shall send notice of the hearing on an objection to a solar access recordation application to the applicant and to all persons who objected to issuance of the recordation and give notice of the hearing consistent with the procedures of the **(46) zoning ordinance**. The hearing shall be held according to the rules of the **(47) planning commission**, shall be on the record, and open to the public.

(b) In a hearing on an objection to a solar access recordation, the **(48) planning commission** shall consider the requirements for applications set forth in Section 6. The objector shall bear the burden of proof in showing that such requirements have not been satisfied based on written testimony and other evidence submitted by the objector to the **(49) planning director** prior to the prehearing conference. Such testimony and evidence shall support issues raised in the objection filed pursuant to Section 7. New

not yet installed), except to the extent that the exemptions in the solar access recordation itself would allow. The **(65) permit department** shall consult the map showing issued solar access recordations and shall consult the **(66) planning director** concerning any pending applications before issuing development permits. Whenever it appears that granting a development permit might result in a structure that would shade a recorded collector, the department concerned shall give notice by certified mail, return receipt requested, to the recorded collector owner. Any development permit that would result in the shading of a recorded collector is void except to the extent that it authorizes work that would not shade the collector. The recorded owner may appeal the grant of a development permit that purports to authorize a shading structure first by such administrative means as are available and subsequently, if necessary, to **(67) court of general jurisdiction**.

(b) Pending the resolution of the appeal, the recorded owner may petition **(68) court of general jurisdication** to issue a preliminary injunction to stop construction of such part of a structure as may shade the recorded collector. The party proposing to build the structure shall bear the burden of showing that the structure would not shade. If the court finds that the structure would shade, the development permit may be declared void to the extent the structure would shade. If the structure has already been built to the extent that it shades the recorded collector, the court may order removal of the shading part or order the payment of damages using the measure of damages in Section 11. The recorded owner shall be entitled to the payment of appropriate damages, plus court costs, plus reasonable attorney's fees, as against either the City or the constructing party, or both.

(c) No one shall plant any vegetation that could shade a recorded collector during solar heating hours (or a recorded collector location if it is not yet installed) after issuance of a solar access recordation. After receiving notice of a solar access recordation, no one shall permit any vegetation on his or her property to grow in such a manner as to shade a recorded collector during solar heating hours (or a recorded collector location if it is not yet installed, unless the vegetation is specifically exempted in the recordation.

(d) If vegetation is not trimmed as required by Section 10(c), the recorded owner or the City on complaint by the recorded owner shall give notice that trimming is required by certified mail, return receipt requested, to the owner or registered lessee of the property where the vegetation is located. If the property owner or lessee fails to trim the vegetation within **(69) 30?** days after receiving this notice, the recorded owner or the City may petition the **(70) court of general jurisdiction** for relief. The court may order the property owner or lessee to trim the vegetation and to pay damages, court costs, and reasonable attorney's fees to the complainant.

(4) The recorded owner causes or allows shade to the extent that the minimum solar collector energy contribution standard is no longer satisfied, or

(5) Upon request of the recorded owner.

(j) The transfer of title to property subject to a solar access recordation shall not change the rights and duties provided for in this Ordinance except that such recordation shall be void to the extent that a solar access easement or deed covenant provides at least equal solar access protection.

Section 11 Repurchase of Recordation

(a) Any recordation issued pursuant to this Ordinance is subject to the repurchase requirements of this Section. A recorded collector owner may require the City to prove that the public interest is best served by repurchase of the solar access recordation before a repurchase may be made.

(b) Solar access recordations shall contain a condition clearly stating that at any time the City may repurchase all or part of the rights granted by the recordation, with the qualification listed in Subsection (a). At the time of the recordation application, the recorded owner shall agree in writing to follow a procedure for valuing the recordation at the time of any buy-back as follows:

(1) Arbitration. In Section 6(b)(11) of this Ordinance the recorded owner agrees as a condition of obtaining a recordation to submit to binding arbitration the value of the recordation and the damages to be paid if the City diminishes in whole or in part the rights protected by the recordation. The arbitration shall be held pursuant to the rules of the American Arbitration Association. The presumptive measure of damages shall be the greater of the present net worth of the collector and associated equipment or the discounted present worth of the difference in energy costs with and without the collector for the remaining life of the collector and associated equipment, plus the cost of removing the collector (and repairing or putting on a new roof, siding, etc. if needed), plus the cost of providing mechanical equipment properly sized to perform the task formerly assumed by the collector and associated equipment, plus the costs to the recorded owner of the repurchase proceedings. The burden of showing the amount of these presumptive damages shall be on the recorded owner. The City shall be given the opportunity of showing by clear and convincing evidence that the actual damages are less than would be calculated by this formula and the extent of the actual damages.

City Council or Board of Comm.

Name ______________________

City Council or Board of Comm.

Name ______________________

ORS 215.110 or ORS 227.090

Name ______________________

City Council or Board of Comm.

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HM:cs/2527B/03/18/81

S O U T H B U R Y   P L A N N I N G   C O M M I S S I O N

T O W N   O F   S O U T H B U R Y,   C O N N E C T I C U T

Amendment of Subdivision Regulations (Solar Access)
Proposed: 3/3/81
Revised: 4/7/81

SECTION I - GENERAL PROVISIONS

A. Add four new subparagraphs to Par. 1.2 Definitions to define solar access, solar energy system, passive solar energy system, and building orientation, as follows:

"1.2.9 Solar Access: The term "solar access" means the access to unobstructed direct sunlight required by a solar collector for its efficient operation."

"1.2.10 Solar Energy Sytem: The term "solar energy system" is an energy system which converts solar energy to useable thermal, mechanical chemical, or electrical energy to meet all or a significant part of a dwelling's energy requirements. As used in these regulation the primary application of a solar energy system is the conversio of solar radiation to thermal energy to meet all or part of a dwelling's heating and domestic hot water requirements. This con version is accomplished in the following manner: Solar radiation is absorbed by a transport medium, and distributed to a point of use. The performance of each operation is maintained by automatic, manual or architectural controls. An auxiliary energy system is usually available both to supplement the output provided by the solar energy system and to provide for the total energy demand should the solar energy system become inoperable."

"1.2.11 Passive Solar Energy System: The term "passive solar energy system" refers to a solar energy system where the collector and thermal storage components are integrated, requiring no transport medium for solar-heated fluid and usually being an essential architectural component of the building.

"1.2.12 Solar Collector: The term "solar collector" refers to a device or combination of devices, structures or parts of a device or structure that require access to sunlight in order to transform direct solar energy into thermal, mechanical, chemical, or electrical energy that will contribute significantly to a structure's energy supply."

"4.8.1 by avoiding cuts or fills which result in potential soil erosion and excessive tree removal, which disturb water resources, or which would adversely affect the solar access of the tract;"

G. Amend subparagraph 4.8.4 of Par. 4.8 Natural Features to require that the planning and design of a subdivision take into account existing vegetation which serves energy conservation purposes as follows:

"4.8.4 by avoiding removal of large isolated trees and desirable woods and other vegetation, particularly those existing plant materials which serve as wind barriers and aid energy conservation."

H. Amend subparagraph 4.9.5 Lot Lines of Par. 4.9 Building Lots to permit lot lines to take into account orientation to the sun as follows:

"4.9.5 Lot Lines: Insofar as practicable, the side lot lines of all lots shall be at right angles or radial to the street on which the lot has frontage, unless the purpose of lot line orientation other than those mentioned is to secure greater solar access or protection or control thereof. It shall be within the discretion of the Commission to disapprove any lot crossed by a municipal boundary line, and, in the event of such disapproval, such boundary line shall be made to constitute one of the lot lines."

I. Amend subparagraph 4.10.2 On-Site under Par. 4.10 Sewer and Water to require leaching fields to be proposed in locations to aid solar energy by adding a new subparagraph 4.10.2c as follows and relettering the other subparagraphs accordingly:

"4.10.2c Provided soil and topographic conditions permit, primary and reserve leaching fields shall be planned and located to the south of a proposed house location whenever such location will aid the use of solar energy systems due to improved solar access caused by regrading and tree removal associated with the installation of the sewage disposal system."

J. Amend subparagraph 4.11.2b under subparagraph 4.11.2 Street Planning of Par. 4.11 Street Planning and Design to require that streets be oriented in an east-west direction whenever possible to aid the use of solar energy systems as follows:

"4.11.2b Streets should, in general, follow the contour of the land and should have a location and grade which accomplishes an attractive layout and development of the land, which preserves natural terrain, large isolated trees and desirable woods and other vegetation and which will enhance property values in the subdivision. When few natural constraints exist which limit street layout and location, such as, but not limited to, steep slopes and unsuitable soils, streets shall have an east-west orientation to the greatest extent possible with acceptable variations of 10° to the northwest and 25° to the southwest in order to provide for orientation of lots and buildings to the south, and thereby to encourage the use of solar energy systems."

4.24.1 by taking advantage of southerly exposures, proposed lots and development thereon shall have adequate solar access to the maximum extent possible.

4.24.2 proposed building locations and orientations required under subparagraph 3.2.8 shall be such that each dwelling has maximum solar access."

C. Providing for Adequate Solar Access: As a guide in providing for the maximum solar access possible, the following factors should be considered:

C-1. Proposed Street Layout: Streets should have an east-west orientation whenever possible, with acceptable variations of 10° to the northwest and 25° to the southwest. Due to topographic or soil conditions, or existing street layouts, such an orientation may not be desirable or acceptable to the Planning Commission or the applicant since excessive grading or distrubance of wetlands would be required or an undesirable pattern of circulation result. Each subdivision must be reviewed individually as to conflicts between the provision of adequate solar access, the preservation of existing natural features on the tract, and desirable circulations patterns.

C-2. Lot Orientation: Lots should be arranged so as to take advantage of south-facing slopes on the tract. The longer axis of all minimum-sized lots should be oriented north-south whenever possible in order to minimize the shading of solar collectors from off-site development, vegetation or other natural features. On large lots, lot orientation may not be a critical factor, depending on other characteristics of the tract of land.

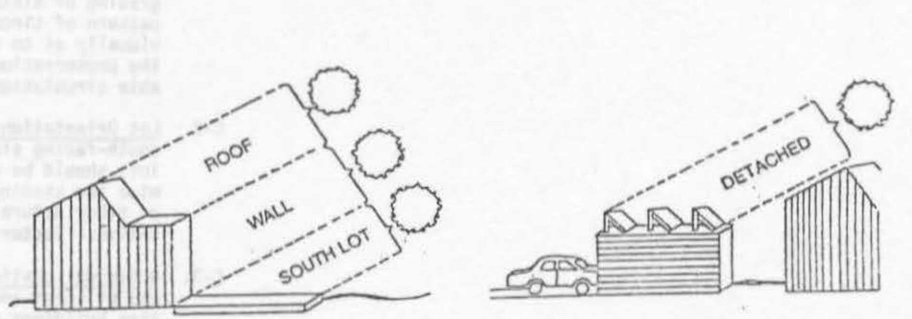
C-3. Building Location: Proposed development on the lots should enable the use of solar energy systems to the maximum extent possible by: a) locating buildings on south-facing slopes and as far north on the lot as possible in order to minimize the shading of solar collectors from on-site and off-site development, vegetation or other natural features; b) orienting buildings so that the longest axis is east to west. Such an orientation may result in house orientations which vary from the normal orientation whereby the longest house axis parallels the street. The Commission realizes that other orientations may be possible depending on architectural type and type of solar energy system, but that in most instances the stated orientation will achieve maximum solar access.

C-4. Sewage Disposal Location: Sewage disposal leaching fields should be located to the south of proposed house locations, unless soil conditions are not suitable or unless such a location would compel the use of an otherwise unnecessary pumped septic system. Such a location will aid the use of solar energy systems, since regrading and tree removal associated with the construction of leaching fields will reduce potential shading problems caused by existing vegetation.

C-5. Limits of Vegetation Control: In Southbury, most subdivisions are located on land that is at least partially forested. Therefore, one of the biggest problems in obtaining adequate solar access is the extent of tree removal and/or pruning necessary to keep the south wall of a dwelling free from shadows. It will not be necessary to cut down every tree to the south of a dwelling in order to obtain adequate solar access; trees further to the south may require only selective pruning. But the necessary area of tree removal and/or pruning may be quite large, depending on orientation and degree of slope, and may be too large to enable the effective use of solar energy systems without designating solar easements. As a guide in determining whether or not the use of solar energy systems is feasible on proposed lots without designating a solar easement, Par. 3.2.19 requires that the area of tree removal and/or pruning be shown on the site plan. The Planning Commission encourages the applicant to designate solar access easements whenever necessary. It is not intended, however, that any necessary tree removal be

D-1. Levels of Solar Access: There are four types of solar access: rooftop, south-wall, south-lot and detached collector access. Each type refers to the location of the solar collector and is shown in the figure below:

Levels of Solar Access



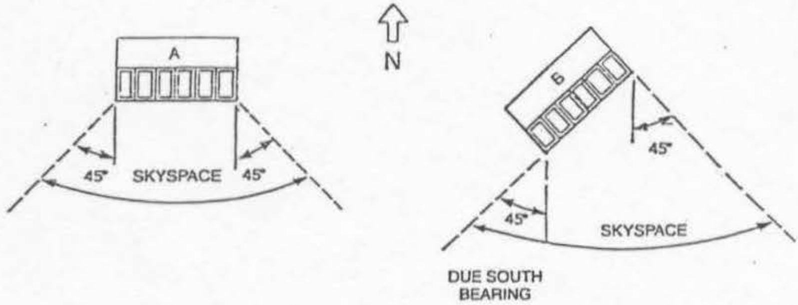
Source: "Site Planning for Solar Access, A Guidebook for Residential Developers and Site Planners", published by the U. S. Department of Housing and Urban Development, Contract Number: H-2573 and prepared by the American Planning Association.

D-2. Shadow Lengths: The length of a shadow cast by an object depends on the following characteristics of the land on which the object is located: a) orientation of slope, b) degree of slope, and c) time of day. For determining shadow lengths in the Town of Southbury, Table A (attached) should be used.

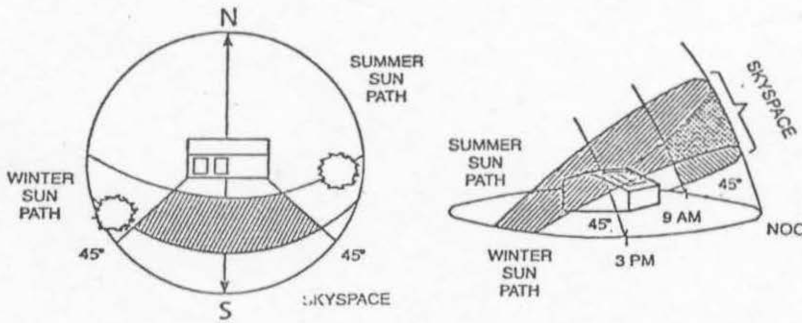
To calculate the shadow length of an object, multiply the height of the object by the factor in the table. For example, a tree which is 50 feet tall, located on a 10% slope priented to the east, will produce a shad- 200 feet long at 9:00 A.M., 110 feet long at noon, and 470 feet long 3:00 P.M.

D-3. Solar Skyspace: It is not necessary for a solar collector to be unobstructed by shadows from sunrise to sunset. That portion of the sky which must remain unobstructed for a solar collector to operate efficiently is defined as skyspace and is partially determined by the sun's position on December 21 the day of the year when shadows are longest. Approximately 86% of the sun's energy is received between the hours of 9:00 A.M. and 3:00 P.M. at north latitude 40° on December 21. (Southbury's north latitude is approximately 41°30') On that date at 9:00 A.M. the sun is located 45° east of

Solar Skyspace (Plan View)



Solar Skyspace (Plan and Isometric Views)



Source: "Site Planning for Solar Access, A Guidebook for Residential Developers and Site Planners", published by the U.S. Department of Housing and Urban Development, Contract Number: H-2573 and prepared by the American Planning Association.

COUNTY OF SANTA CLARA, CALIFORNIA

AN ORDINANCE ADDING CHAPTER II (COMMENCING WITH SECTION C14-10) TO DIVISION C14 OF TITLE C OF THE SANTA CLARA COUNTY ORDINANCE CODE REQUIRING SOLAR WATER HEATERS FOR RESIDENTIAL DOMESTIC USE

The Board of Supervisors of the County of Santa Clara, State of California, do ordain as follows:

SECTION 1. FINDINGS. The Board of Supervisors of Santa Clara County hereby makes and concurs with the following findings:

(a) The Santa Clara County Energy Task Force found that the residents of Santa Clara County face the uncertainty of conventional energy source supply and the certainty of rapid cost increases for conventional energy sources as a result of conventional energy scarcity and the high expense and lack of new energy production and distribution facilities.

(b) The conservation of fossil fuels used for domestic water heating is necessary to reduce the need for new energy production facilities and conserve existing supplies for other essential uses.

(c) There is a clear State and Federal policy to promote the maximum utilization of solar energy. Official statements of the President and the Governor, findings of the Congress and the California Legislature and previous findings of the California Public Utilities Commission have concluded that the use of solar energy will reduce dependence on foreign oil, increase national security, improve the national balance of payments, reduce pollution, increase jobs in the domestic energy sector, increase the rate at which utilities can augment energy supplies in the short term and reduce inflationary pressures. (CPUC Decision No. 91272, r.e. OII 42, January 29, 1980.)

Title 24, Part 6, Article 1, Section T-20-1406, applicance efficiency standards for new fossil fuel water heaters.

(i) A solar water heater requirement for residences will be cost effective in that the range of anticipated costs of domestic water heating with solar energy is lower than the range of anticipated costs for domestic water heating with natural gas or electricity.

SECTION 2. Chapter II (commencing with Sec. C14-10) is added to Division C14 of Title C of the County of Santa Clara Ordinance Code to read:

CHAPTER II. SOLAR WATER HEATERS FOR RESIDENTIAL DOMESTIC USE

Sec. C14-10. Intent.

The intent of this Chapter is to restrict the use of non-renewable fossil fuels and encourage use of renewable alternatives as the primary heat source for residential domestic water heating.

Sec. C14-11. Definitions.

(a) A "solar energy system" means either of the following:

1. Any solar collector or other solar energy device whose primary purpose is to provide for the collection, storage, and distribution of solar energy for space heating or cooling, or hot water heating; or

2. Any structural design feature of a building, whose primary purpose is to provide for the collection, storage, and distribution of solar energy for space heating or cooling, or hot water heating.

(b) "Solar access" is defined as the provision of unobstructed, direct sunlight to at least twenty (20) square feet of roof area per bedroom in the dwelling,

(d) All plumbing required pursuant to this section shall comply with applicable State and local laws and regulations.

Sec. C14-13. Solar water heater requirement for new residential construction.

(a) Any other provision of this ordinance code to the contrary notwithstanding, no building permit shall be issued by the Department of Building Inspection for a new residential building as specified in paragraph (b) hereof, unless said building includes the use of a solar energy system as the primary means of heating domestic potable water.

(b) Said prohibition shall become operative for permits for residential buildings applied for on or after February 1, 1981.

(c) All such systems shall comply with applicable State and local laws and regulations.

Sec. C14-15. Exemptions.

The owner of a residential building may request of the Department of Building Inspection an exemption from the requirements contained in this Chapter when any of the following conditions exist:

(a) Lacks solar access -- Topographic conditions, development (or possible development allowed by existing zoning), or existing trees on or surrounding the residential site or probable location of the solar collection system preclude effective use of the solar energy system due to shading; or

(b) Not cost-effective -- Solar water heating is not cost-effective for the applicant if the present value life-cycle cost over ten (10) years for solar water heating is greater than that for any other commercially available water heating technology which could be or is effectively used at the site; or

ORDINANCE NO. NS

AN ORDINANCE ADDING SECTION C14-14 TO CHAPTER II OF DIVISION C14 OF TITLE C OF THE SANTA CLARA COUNTY ORDINANCE CODE REQUIRING INSTALLATION OF SOLAR WATER HEATERS FOR RESALE OF RESIDENTIAL BUILDINGS

The Board of Supervisors of the County of Santa Clara, State of California, do ordain as follows:

SECTION 1. Section C14-14 is added to Division C14 of Title C of the Santa Clara County Ordinance Code to read:

Sec. C14-14. Solar water heater requirement for resale of residential buildings.

(a) All residential buildings, as specified in paragraph (b) hereof, for which a building permit was applied for prior to February 1, 1981, shall be fitted with a solar energy system as the primary means of heating domestic potable water within one hundred twenty (120) days after recording of the deed transferring title to the property as a result of the sale of the property or after the recording of a contract of sale pursuant to Civil Code section 2985. Failure to comply with the requirements of this Chapter shall not prevent recordation of any legally recordable document.

(b) The requirements of paragraph (a) shall become operative for structures for which the recording of the deed or contract of sale was made on or after January 1, 1983.

(c) All such systems shall comply with all other applicable State and local laws and regulations.

(d) Existing structures with existing solar systems that supply the primary means of heating domestic potable water are exempt from the requirements of this section.

(e) Existing condominiums and condominium conversions are exempt from the requirements of this section.

V. SAMPLE STRATEGIES

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Maintain 55 MPH Speed Limit	• Not Local Alternative; Usually State Or Federal, But Implementable At Local Level	X			NA	NA
	• Education/Information			X	NA	NA
• Implement Gasoline Rationing	• Requires Federal Legislation, Except For Municipal Vehicles, Which Can Be Regulated Locally	X			NA	NA
• Implement One-Day-A-Week Driving Ban	• Not Feasible At Local Level, Except For Partial Bans On Some Streets	X			NA	NA
• Increase Use Of Right-Turn-On-Red	• Statewide Function; Can Be Enforced Locally	X			NA	NA
• Increase Energy Efficient Driving Practices	• Driver Education	X			NA	NA
	• Driver Clinics	X			NA	NA
	• Advertising And Promotion			X	NA	NA
• Increase Use Of Telecommunications	• Municipal Procurement For Own Operations	X			NA	NA
	• Advertising Campaign			X	NA	NA

Source: Hittman Associates, Comprehensive Community Energy Planning, November 1978, Volume I.

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Civic Awards To Cooperating Businesses			X	NA	NA
• Increase Efficiency Of Vehicles	• Excise Tax	X			NA	NA
	• Registration Tax	X			NA	NA
	• Personal Property Tax	X			NA	NA
	• Gasoline Tax	X			NA	NA
	• City Fleet Size	X			NA	NA
	• Parking Rates		X		NA	NA
• Increase Use Of Improved Efficiency Street Lighting	• Municipal Regulations	X			NA	NA
	• Procurement Policies	X			NA	NA
• Reduce Street Width	• Zoning And Subdivision Regulations	X	X		X	
• Reduce Amount Of Urban Streets	• Municipal Operations	X			X	X
• Decrease Number Of Urban Streets	• Capital Improvements Program	X			X	X
• Increase Synchronization Of Traffic Lights	• Municipal Operating Procedures	X			NA	NA

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Staggered Work Hours	• Mandatory - Municipal Employees	X			NA	NA
	• Advertising/Promotion For Local Businesses			X		
• Four Day Work Week	• Mandatory - Municipal Employees	X			NA	NA
	• Advertising/Promotion For Local Businesses			X	NA	NA
• Improve Urban Goods Movement	• Municipal Regulations Re: Truck Delivery	X			X	X
	• Regulations Re: On-Street/Off-Street Loading Stipulations Through Zoning	X			X	
	• Parking Bans	X			X	X
	• Develop Central Warehouse Facilities Through Financial Incentives					
	- Land Write-Down		X		X	
	- Low-Interest Loans		X		X	
	• Develop Truck Lanes On Abandoned Rail R.O.W.		X		X	X
• Increase Vehicle Maintenance	• Not Local Alternatives - State (Except For Municipal Vehicles)	X			NA	NA
	• Education/Information			X	NA	NA

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Bicycle/Pedestrian Mode	• Citywide Network Of Bicycle Routes Established Through Municipal Regulations		X		X	X
	• Improve Bike Parking Facilities		X			X
	• Allow Bicycle "Piggy-Backing" On Buses		X		NA	NA
	• Mark Signs And Lanes Clearly - Municipal Traffic Regulations		X		NA	NA
	• Use Of Zoning To Encourage Or Require Bike Paths And Parking Facilities In New Development		X		X	
	• Street Improvements		X		X	X
	• Develop Skywalks And Other Pedestrian Walks	X	X		X	X
	• Create People Mover Systems		X			
	• Create "Pedestrian-Only" Environments Through:				X	X
	- Zoning	X	X		X	
	- Financial Incentives For Redevelopment		X			X
	- Loans		X		X	X
	- Real Property Tax Abatement		X			X

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Advertising And Promotion			X	NA	NA
• Increase Use Of Parking Bans	• Reduce Parking Supply					X
	- Temporal Restrictions	X			X	X
	- Parking Bans	X			X	X
	- Permits	X			X	X
	- Meters	X			X	X
	• Use Zoning To Limit Parking Spaces And Their Location	X			X	X
	• Parking Surcharge For Fee Parking	X			NA	NA
• Increase Carpooling	• Preferential Traffic Control		X		NA	NA
• Increase Vanpooling	• Preferential Parking		X			X
	• Carpool Matching Service		X		NA	NA
	• Preferential Toll Policies		X		NA	NA
	• Lease Vans To Businesses		X		NA	NA
	• Advertising - Persuasion For Private Businesses		X		NA	NA

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Residential; Commercial/Municipal/Institutional/Industrial (Non-Residential)

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Building Of Local Recreational Facilities	• Municipal Facilities/Capital Improvements Program	X			X	X
	• Incentives To Developers - Zoning		X		X	
	• Incentives To Developers - Financial - Real Property Tax Abatements		X		X	
• Locate Housing Near Employment And Services	• Zoning Ordinance	X	X		X	
	• Real Property Tax Abatement		X			X
	• Infrastructure Provisions/Improvements For Redevelopment/New Development		X		X	X
• Increase Use Of Mixed/Multiuse Facilities	• Zoning Ordinance	X	X		X	
	• Real Property Tax Abatement For Conversion		X			X
	• Infrastructure Provisions/Improvement		X		X	X
	• Major Rehabilitation Loans For Site Development		X			

Land Use: Transportation

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Restricted Transportation Areas	• Municipal Regulations	X				X
	• Zoning Ordinance (New Development)	X	X		X	
• Increase Use Of Mass Transit	• Pricing Policies		X		NA	NA
	• Provide Park And Ride Facilities		X		X	X
	• Preferential Traffic Control		X		NA	NA
	• Restricted Transportation Areas		X		X	X
	• Ensure Ridership Safety And Comfort		X		NA	NA
	• Locate More Efficient Bus Stops And Terminals		X		X	X
	• Limited Parking; Parking Bans; On-Street/Off-Street Parking Regulations		X		X	X
	• Institute Easier Fare Collection Procedures		X		NA	NA
	• Provide Paratransit Facilities		X		NA	NA
	• Provide Better Information Services			X	NA	NA
	• Advertising And Promotional Campaigns			X	NA	NA

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Residential; Commercial/Municipal/Institutional/Industrial (Non-Residential)

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Solid Waste Heat Recovery	• Infrastructure Provisions And Improvements	X			X	X
• Increase Use Of District Heating And Cooling Plants	• Information Service			X	X	X
• Increase Use Of Total Energy Systems	• Individual Building/Plant Consultation			X		X
• Increase Use Of Integrated Utility Systems						
• Increase Use Of On-Site Alternative Energy Sources (Wind, Solar, Water): Residential	• Low-Interest Loans		X		X	X
	• Grants To Low-Income Households		X		X	X
	• Real Property Tax Credits		X			X
	• Favorable Utility Rate Structures, If Municipal Utility		X		X	X
	• Real Property Tax Abatements (To Developers Of Rental Property)		X		X	X
	• Sales Tax Credit/Exemptions		X		X	X
	• Zoning Ordinance		X		X	
	• Real Property Tax Exemptions		X			

Land Use: Residential; Commercial/Municipal/Institutional/Industrial (Non-Residential)

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Advertising Campaigns			X	X	X
	• Information Services			X	X	X
• Increase Use Of On-Site Alternative Energy Sources (Wind, Solar, Water): Commercial/Municipal/Institutional/Industrial (Non-Residential)	• Municipal Procurement Policies	X			X	X
	• Infrastructure Provisions/Improvements	X			X	
	• Real Property Tax Credits		X			
	• Real Property Tax Abatements		X			X
	• Real Property Tax Exemptions		X			X
	• Rate Ordinance (Municipal Utility)		X		X	X
	• Sales Tax Credit/Exemption		X		X	X
	• Zoning Ordinance		X		X	X
	• Advertising Campaign			X	X	X
	• Information Services			X	X	X
	• Individual Building Consultation			X		X

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Industrial

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Weatherization • Increase Insulation	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
	• Mandatory Compliance At Sale, Resale, Or Lease Through Disclosure And Inspection	X			X	X
	• Real Property Tax Credits		X			X
	• Low-Interest Loans		X			X
	• Sales Tax Credit/Exemptions		X		X	X
	• Individual Plant Consultation			X		X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X
	• Civic Awards For Cooperating Businesses			X		X
• Increase Use Of Localized Radiative Heating	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	X
	• Personal Property Tax Credits		X			X
	• Sales Tax Credit/Exemption		X			X
	• Individual Plant Consultation			X		X

Land Use: Industrial

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Advertising Campaigns			X	X	X
	• Information Services			X	X	X
	• Seminars/Workshops			X	X	X
	• Civic Awards For Cooperating Industries			X		X
• Increase Use Of Process Heat	• Low-Interest Loans For Necessary Structural Conversions		X			X
	• Real Property Tax Credits		X			X
	• Individual Plant Consultation			X	X	X
	• Information Services			X	X	X
	• Civic Awards For Cooperating Industries			X		X
	• Advertising Campaign			X	X	X
• Reduce Lighting Use	• Municipal Ordinance	X			X	X
	• Zoning Ordinance (Amendment)	X	X		X	X
	• Advertising Campaign			X	X	X
	• Individual Building Consultation			X		X
	• Civic Awards For Cooperating Industries			X		X
	• Information Services			X	X	X

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Commercial/Municipal/Institutional

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Advertising Campaign			X	X	X
	• Civic Awards For Cooperating Businesses			X		X
• Increase Individual Tenant Metering	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
	• Advertising Campaign			X	X	X
• Set Back Thermostat During Unoccupied Hours	• Advertising Campaign			X		X
	• Information Services			X		X
• Increase Use Of Automatic Temperature Control System	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
	• Real Property Tax Credit		X		X	X
	• Sales Tax Credit/Exemption		X		X	X
	• Advertising			X	X	X
	• Information Services			X	X	X
	• Individual Building/Plant Consultation			X		X

Land Use: Commercial/Municipal/Institutional

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Decrease Use Of Escalators And Elevators	• Municipal Ordinance Re: Operating Procedures	X				X
	• Advertising Campaign			X	X	X

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Metering Of Certain Appliances	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
• Increase Energy Use Disclosure At Time Of Sale (Resale Or Lease)	• Municipal Ordinance	X			X	X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X

Land Use: Commercial/Municipal/Institutional

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Double Glazing/ Storm Windows	• Municipal Regulations For Own Operations	X			X	X
	• Municipal Ordinance	X			X	X
• Increase Use Of Building Insulation	• Building Code Amendment	X			X	
• Increase Weatherization	• Mandatory Compliance At Sale, Resale, Or Lease Through Disclosure And Inspection	X			X	X
• Increase Use Of Reflective Glazing	• Real Property Tax Credit		X			X
	• Low-Interest Loans		X			X
	• Sales Tax Credit/Exemptions	X				X
	• Individual Building Consultation			X		X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X
	• Civic Awards For Cooperating Businesses			X		X
• Decrease Operating Hours	• Municipal Regulations For Own Operations	X				X
	• Advertising Campaign			X		X
	• Civic Awards For Cooperating Businesses			X		X

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Sales Tax Credit/Exemption		X		X	X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X
• Reduce Outdoor Gas Lights	• Municipal Ordinance	X			X	X
	• Advertising Campaigns			X	X	X
• Decrease Use Of Heated Swimming Pools	• Municipal Ordinance	X			X	X
	• Advertising Campaigns			X	X	X
• Increase Use Of Improved Efficiency Appliances	• Sales Tax Credit/Exemption Or Surtax		X		X	X
• Encourage High Efficiency Appliances	• Advertising Campaign			X	X	X
• Increase Use Of High Efficiency Air Conditioners	• Advertising Campaign			X	X	X
• Reduce Use Of Gas Pilot Light	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
	• Housing Code Amendment	X				X

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
	• Advertising Campaigns			X	X	X
• Reduce Lighting Use	• Municipal Ordinance	X				X
	• Advertising Campaign			X	X	X
	• Information Services			X	X	X
• Increase Hot Water Tank Insulation	• Municipal Ordinance	X			X	X
	• Housing Code Amendment	X				X
	• Building Code Amendment	X			X	X
	• Real Property Tax Credits		X			X
	• Low-Interest Loans		X			X
	• Grants To Low-Income Families		X			X
	• Sales Tax Credit/Exemption		X		X	X
	• Advertising Campaigns			X	X	X
	• Information Services			X	X	X

STRATEGY/ALTERNATIVES COMBINATIONS (Continued)

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Demand Metering		X			X	X
• Increase Individual Metering Of Multifamily Units	• Building Code	X			X	
	• Municipal Ordinance	X			X	X
	• Advertising Campaign			X	X	X
	• Information Services			X	X	X
• Increase Use Of Landscaping And Shading	• Zoning Ordinance/Subdivision Regulations	X	X		X	
	• Real Property Tax Credit		X			X
	• Low-Interest Loans		X		X	
	• Grants To Low-Income Households		X		X	
	• Sales Tax Credit/Exemption		X		X	X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Use Of Multifamily Housing	• Zoning Ordinance	X	X		X	
	• Real Property Tax Abatement		X		X	X
	• Major Rehabilitation Loans		X			X
	• Infrastructure Provisions/Improvements		X		X	X
• Increase Use Of Two-Story Houses	• Zoning Ordinance		X		X	X
	• Real Property Tax Abatement		X		X	X
• Increase Use Of Solar Clothes Drying	• Advertising Campaign			X	X	X
• Reduce Temperature Of Hot Water 150° to 120°	• Advertising Campaign			X	X	X
• Increase Use Of Heat Pumps In Lieu Of Electric Resistance Heating	• Municipal Ordinance	X			X	X
	• Building Code Amendment	X			X	
	• Real Property Tax Credits		X			X
	• Low-Interest Loans		X		X	X
	• Grants To Low-Income Households		X		X	X

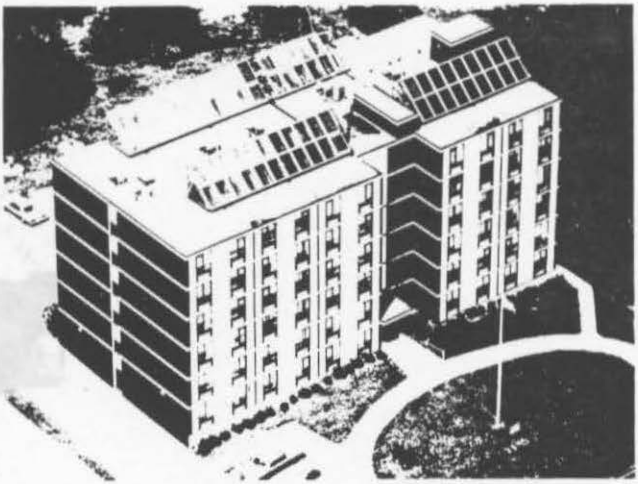
STRATEGY/ALTERNATIVES COMBINATIONS

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Increase Weatherization	• Municipal Ordinance	X			X	X
• Increase Dwelling Insulation	• Housing Code Amendment (Weatherization)	X				X
• Increase Use Of Double Glazing/ Storm Windows	• Building Code Amendment	X			X	
	• Mandatory Compliance At Sale, Resale, Or Lease Through Disclosure And Inspection	X			X	X
	• Real Property Tax Credits		X			X
	• Low-Interest Loans		X		X	X
	• Grants To Low-Income Households		X			X
	• Sales Tax Credit/Exemption		X		X	X
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X
• Reduce Glass Area	• Building Code Amendment	X			X	
	• Rehabilitation Loans		X			X
	• Real Property Tax Credits		X			X
	• Advertising Campaigns			X	X	X
	• Information Services			X	X	X

Land Use: Residential

ALTERNATIVE	STRATEGY	MANDATORY	INCENTIVE	EDUCATIONAL	NEW CONSTRUCTION	EXISTING CONSTRUCTION
• Optimal Placement Of Glazing	• Zoning Ordinance/Subdivision Regulation		X		X	
• Increase Use Of Shading Overhangs (Roof Overhangs)	• Building Code Amendment	X			X	
	• Information Services			X	X	X
	• Advertising Campaigns			X	X	X
• Increase Use Of Envelope Zoning	• Zoning Ordinance	X	X		X	
• Optimize Building Orientation On Site	• Zoning Ordinance/Subdivision Regulations	X	X		X	
• Increase Use Of Raised Ranch Type Housing (One Floor Underground)	• Zoning Ordinance		X		X	
	• Real Property Tax Abatement		X		X	
• Relax Comfort Conditioning	• Advertising Campaign			X		X
• Set Back Thermostat During Unoccupied Hours And Night	• Information Services			X		X
• Inverted Block Rate Structure						
– Increase Time-Of-Use Metering	• Rate Ordinance (Municipally-Owned Utility)	X			X	X



SENIOR CITIZEN'S RESIDENCE

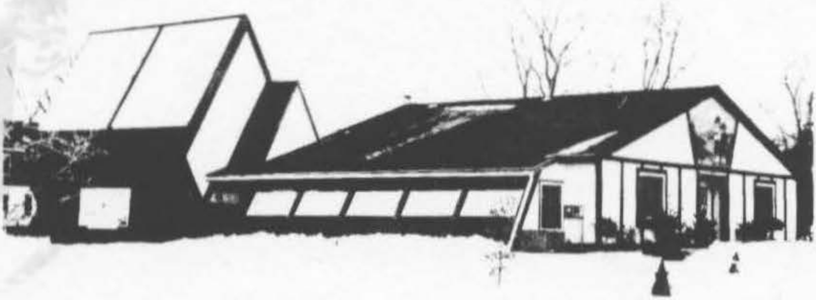
DOVER, NEW JERSEY

In July, 1977, the Dover Housing Authority in Morris County, New Jersey installed a solar domestic water heating system on their six-story senior citizen's residence. The 66 Daystar collector panels provide 60 percent of the hot water used by the building's residents.

The Dover project was funded by an $85,000 grant from the Department of Housing and Urban Development. But even with a five-digit price tag, the system will pay for itself in 10 years, as it is saving some $7,000-$8,000 a year (1978 dollars and energy costs). Peter Cipriano, President of Engineers, Inc., the designers of the system, notes, "As the cost of conventional energy skyrockets, payback periods for solar systems become increasingly viable."

Salvatore Dispenziere, Executive Director of the Dover Authority, is pleased with the project. He notes, "Our project has proved that it is feasible--and desirable--to use the free energy of the sun. Systems such as ours are viable, and we welcome anyone who needs assistance with other solar energy projects and who can benefit from our experience. Hopefully in the future, the extensive use of solar energy in private industry, in commercial centers and housing complexes will be commonplace. Cities fueled by solar energy will take away the dependence on the nations and individuals who control fossil fuels."

Systems components include heat exchangers, the collectors, circulation pumps, and insulated storage tank, and, of course, the existing electric hot water heaters. The panels collect the energy to preheat water for the electrical hot water system, and "heat dumps" relieve excess solar-generated heat during low demand periods."



MOTHER GOOSE NURSERY SCHOOL

WINSLOW, MAINE

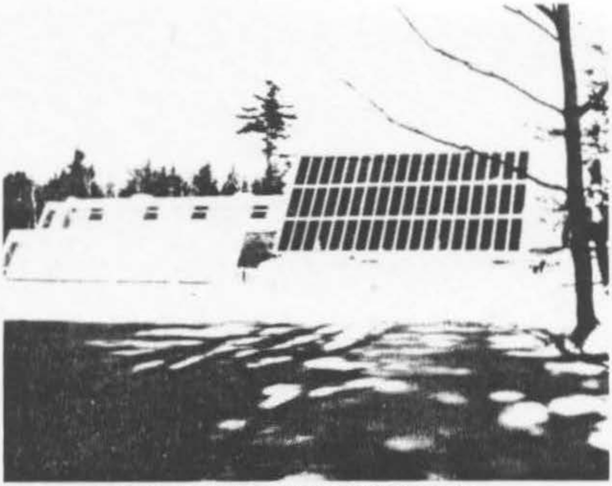
Townspeople have described it as a "spaceship" and "another Noah's ark." The owners of the Mother Goose Nursery School in Winslow, Maine, call their unique active and passive solar heating systems "real money savers."

"With the price of electricity soaring, solar became more and more practical," says Reggie Huard, who, with his wife, Alice, weighed the costs and decided to retrofit their building. "Our system is proof that solar can be added to any house or commercial building at a reasonable cost--even way up here in Maine."

Sixteen flat-plate collectors heat the water in a mammoth 22,000 gallon hexagonal tank which is attached to the side of the school. This 180^{o}-190^{o}F water is then circulated through baseboard radiators in the nursery school. Heating bills for the 6000 square-foot facility now average less than $5 a day, adding up to only one-quarter of previous annual heating bills.

With Robert Multer, an engineer who designed the active and passive system, and Winslow contractor Barry Dolley, the Huards received a DOE grant to retrofit their seven-year old, all-electric school. Work was completed in October 1979, and an open house was held for the community to celebrate the occasion.

An 8'x40' solar greenhouse, where the 65 children who attend the school grow flowers and vegetables year-round, is on the south side of the building. Aquarium-like water tanks store heat, and sliding thermopane glass doors allow heat to flow into the main building.



WILTON, MAINE'S SEWAGE TREATMENT PLANT

Back just after the Arab oil embargo of 1973-74, town officials in Wilton, Maine, 70 miles north of Portland, decided that there must be a better way to power their planned sewage plant than with fossil energy. So they conferred with Consulting Engineers Wright-Pierce, Inc. of Topsham and architect Douglas Wilkie of New York and came up with an unprecedented design which was both energy conserving and utilized the sun's heat.

The building is a strikingly attractive contemporary structure, exposed to the south, and sheltered to the north by a low, bermed roof. Walls are of concrete block faced with brick. The cores of the blocks are filled with insulation. The south-facing window areas are double-glazed. Energy saving technologies for space, water, and process heat include active and passive solar, methane, heat pumps, thermal storage, and gravity pumpings.

The array of active solar collectors heats water in a 500-gallon tank. The water is then distributed throughout the plant to faucets and to the heat-requiring anaerobic digestion processes. The passive solar system provides space heat. The south-facing windows are provided with overhangs to minimize summer overheating.

Methane gas, which is the by-product of the digestion process is combusted in a methane boiler and generator for heating the building and producing electricity. Long-term methane storage also takes place in four 500-gallon tanks located in a mini "tank farm" outside the plant.

In addition, a heat pump removes heat from the effluent as it leaves the plant. The retrieved heat is pumped into space as needed, and the balance is stored in the 500-gallon thermal storage tank.

The plant itself cost $2 million to build, and another $5 million was spent to develop a sewer system. Built in 1979, funding assistance was provided by the Environmental Protection Agency and the state of Maine's Department of Environmental Protection. All in all, the town spent only a little more than if it had constructed a conventional plant. The design of the plant and its processes, however, enable all thermal energy needs to be met by the solar/methane/heat pump system. These savings reduce the overall energy use of the plant by 25%. Town Manager John Donald has calculated a solar payback (based on the town's own portion of the plant's total cost) of about six years.

Mr. Donald is very pleased with the plant and its operation. His only source of discontent is that sewage flows were overestimated by the engineers who designed the plant, so that it operates at only one-third of its capacity. Donald is seeking more sewage to fill the void.

PRINTING HOUSE
NEW YORK, NEW YORK

The revamped Printing House, formerly an obsolete mercantile building, now boasts what its owners call "the largest privately-owned solar system in the world." Over 200 Grumman collectors provide residents with approximately 60 percent of their hot water.

"This building is one of the largest recycling projects ever attempted," says Alan Rose, A.I.A., project manager for the New York City architectural firm of Stephen B. Jacobs and Associates. "It's an ideal demonstration to others in the expanding field of renovation that solar can be retrofitted to urban buildings because of their high percentage of lot coverage and large roof areas."

Because the size of the building insured solar access (there are no skyscrapers that shade the building), the design flexibility was "unlimited," according to the designer. One of the first recycled buildings to be dedicated to energy conservation and solar, the Printing House combines light manufacturing, retail stores, a health club, and 188 apartments.

Although their initial application to the U.S. Department of Housing and Urban Development (HUD) for a solar demonstration grant was turned down, Mountbatten Equities, owners of the project, were determined to go solar. Solar Processes Inc., Mystic, CT., designed a solar system to meet HUD requirements and it was turned on in August, 1980.

"When we first applied for the HUD grant, oil was a lot less than $1 per gallon and we still thought solar would pay off," says Rose. "But now that the price has risen even further and will go higher still, we're tickled with the decision we made."

Another energy saving feature of the eight-story building is a water-to-a heat pump system in every apartment. Circulating water through all of the heat pumps dissipates heat through a closed circuit evaporative cooler on the roof in the summer. In winter, heat is absorbed from a boiler supplied steam converter. This allows simultaneous heating and cooling among various apartments. Units that are cooling dissipate their heat into the circulating water which can then be used by apartments requiring heat.

DISTRICT HEATING SYSTEM

HARRISBURG, PENNSYLVANIA

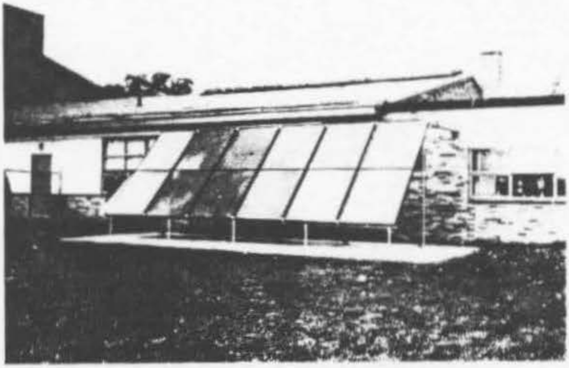
For generations, solid waste in the City of Harrisburg was disposed of in landfills, open dumps, and an old batch-type incinerator, each of which posed potentially serious environmental problems. Studies indicated that the incineration of the refuse in a facility that could generate steam for in-plant uses as well as for export to an existing district heating system was an ideal solution.

To implement the plan, the city formed the Harrisburg Incinerator Authority and directed it to proceed with the design, financing and construction of the steam generating facility. To be included were a ferrous metal recovery unit, a public works maintenance shop, and residue disposal areas. The Authority carried out its mandate and the facilities were place in operation and leased to the city in late 1972.

The facility's steam is sold to the Pennsylvania Power and Light Company for use in its district heating system which serves downtown Harrisburg. Construction of the steam transmission main and the necessary interconnection with the utility's oil-fired steam plant was completed in December 1978. Financing for these projects were provided by a reissue of the Authority's revenue bonds.

In mid-1980, another improvement was added to Harrisburg's waste disposal process: the Sewage Authority began operating its upgraded waste-water plant which increases the treatment level from primary to secondary. The sludge removed from the anaerobic digesters at the new plant is dried and can be either burned in the steam-generating plant or used for agricultural purposes. All told, these ancillary facilities and the steam plant cost almost $17 million to construct, though it is estimated that today's replacement costs would double that figure.

Public and governmental acceptance has continued to grow, and an increasing number of the surrounding municipalities and their contractors are using the plant. In the last quarter of 1980, the facility was operating at 85% of design capacity and has processed more than one million tons of refuse since its construction.



PUBLIC SCHOOL SYSTEM
ROCKLAND, MASSACHUSETTS

With the recent installation of six solar systems and a number of energy conservation measures, Rockland, Massachusetts, school officials hope to slice their energy consumption by more than half. Thanks to a $733,059 Title III Schools and Hospitals Grant from the U.S. Department of Energy, "Rockland will step into the vanguard of energy conserving school systems," according to John Pini, the school's energy conservation manager.

Starting back in 1974 when superintendent John Rogers organized an energy data collection system, the Rockland Schools have been working on ways to cut their energy demand. A program of low-cost energy measures was initiated in all of the school system's seven buildings in 1977. Thermostats were lowered. Wattage in incandescent light fixtures was reduced. Burners were tuned. After these improvements were completed, oil consumption in the schools began its downward slide.

With advice from a committee of school, community, and business representatives, major steps were taken to tighten up the least energy efficient buildings in the system. Using regular budget funds in 1979, the Memorial Park School was totally insulated and internal storm windows were installed.

Six of the seven schools now have solar space and water heating systems designed by Sippican Solar Systems Inc. of Marion, Massachusetts. So that students can see them at work, some of the collectors are ground-mounted. In addition, the piping and monitoring equipment has been left exposed and paint bright yellow so the path of the system can be traced. A Trombe wall is in use at one of the elementary schools.

"The faster we become energy independent, the better," says Pini. "Our schools are being hard-hit by inflation. We need money for other things besides heating oil. If we can save energy and money, the main goal of the schools--providing children with the best education programs available--can be met."

ST. PAUL'S EPISCOPAL CHURCH

BROOKLINE, MASSACHUSETTS

With fuel costs soaring like a Gothic spire, many churches in the Northeast have become prohibitively expensive to heat. That is, unless the congregation decides to go solar, which happened at St. Paul's in Brookline, Massachusetts.

Built in 1851, St. Paul's has recently installed 22 solar panels which are used as part of the building's heating system. The solar installation was designed and implemented by Contemporary Systems, Inc., of Walpole, New Hampshire.

A fire in January 1976 had destroyed the roof and a large portion of the interior, leaving only the stone walls standing. In the summer of 1978, members of the parish voted to proceed with rebuilding, including installation of a solar heating system. Construction began in August 1979.

The rector of the parish, Rev. George Chapman, cites theological, ecological and financial reasons for the decision to use solar heating. "God made the world and said you take care of it. We have that responsibility. This is an opportunity to translate that concern into action. We hope this will be an example to others--churches, public buildings and homes." The system also makes sense financially Chapman says, for "as the price of heating oil goes up, the payback time for the solar system will be shorter."

The solar heating system uses hot air forced through 704 square feet of collectors and ducted into a 1,026 cubic foot rock storage bin in the basement. The bin is insulated with enforced concrete block walls and four inches of foam, and is filled with crushed stone. A large fan in the basement redelivers the heat from storage when needed, and distributes it evenly. In the summer, an exhaust fan cools the building by exhausting hot stratified air from the church's 44-foot high ceilings, and draws cool air through the floor registers from the basement. Oil is used as a backup fuel.

LOW-RISE OFFICE BUILDING

BANGOR, MAINE

In Bangor, Dr. Moshe Myerowitz's new office is a "building within a building," using passive solar energy to meet all of its heating needs.

Known to architects as an "envelope" design, it operates on the simple principle that hot air rises and cool air sinks. George Daniels of Mason Hill Builders, general contractor of the project, says it is the only commercial application of the envelope design in the state.

"The envelope design added about 5 percent to the total construction costs," notes Daniels. "But fuel savings will pay back that added cost in a short time."

The office building has 740 square feet of double-glazed, south-facing windows tilted at a 70° angle. The heat captured in the "greenhouse" (the 18" wide space between the inner and outer shells that runs from the foundation to the attic) rises to the heavily insulated roof cavity and falls to the back wall as it cools.

From there, the air travels down a sloping roof to an "airspace" on the north side that separates the two shells, and then down to the crawlspace under the first floor. A ten-inch bed of crushed stone in the crawlspace acts as thermal mass, storing some of the heat before the air circulates to the greenhouse and starts the cycle over again.

The doctor's envelope buildings also uses an active solar domestic water heating system, which should cut his water heating bills by more than half.

MULTIFAMILY DEVELOPMENT

Davis, California

This multi-unit development began with a determination to provide solar energy for space heating and domestic water heating as well as natural cooling. It meets this objective with a clever passive/active solar energy system based on the developer's earlier solar work in single-family housing.

The development began with good site orientation to provide solar access for each of the 95 units in the complex. Basic passive solar features were then added, putting most windows on the south, shading with overhangs and wing walls, using flow-through ventilation, and choosing light-colored roofs. In addition, the design featured a number of advanced energy conservation measures well in excess of even the strict California code requirements.

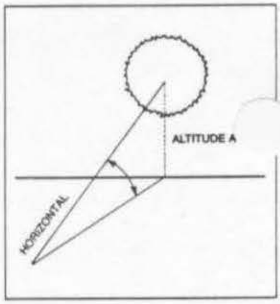
An active solar system was added to provide domestic hot water, backup space heating for the passive system, and cooling using night sky radiation. The last element is unusual and adds considerably to the cost-effectiveness of the system. A plastic glazing is used on the collectors so that when they are operated at night, they provide cooling by radiating built-up heat from the house to the night sky. Warmth or coolness is transferred to the living space by means of a floor slab with coils embedded in it. Additional storage is provided by water tanks.

The system is expected to meet considerably more than 80 percent of the yearly demand for energy for space heating, cooling and hot water. Total energy bills for these functions should be less than $20 per year, at 1979 energy prices. The low cost reflects the major conservation and solar features in the building structure, as well as the generally lower energy use of apartment tenants compared with single-family households.

VII. GLOSSARY

Absorber	- The surface in a collector that absorbs solar radiation and converts it to heat energy; generally a matte black metallic surface is best.
Absorption	- Ratio of solar radiation absorbed by a surface to the amount that strikes it (an important aspect of collector efficiency).
Active Solar Energy Systems	- In contrast to passive solar energy approaches, an active solar energy system utilizes outside energy to operate the system and to transfer the collected solar energy from the collector to storage and its distribution throughout the unit. Active systems can provide space heating and cooling and domestic hot water. The choice of location for active collectors is flexible; rooftops are commonly used.
Air Change	- The method of expressing ventilation rate of a building or room in terms of the number of building volumes or room volumes exchanged in a time period.
Airlock Entry	- A vestibule enclosed with two airtight doors; it reduces heat loss by limiting the movement of heated air.
Air-type Collector	- A collector that uses air for heat transfer.

Altitude - One of two angles used to specify the sun's position at any given time; altitude is the angle of the sun above the horizontal.

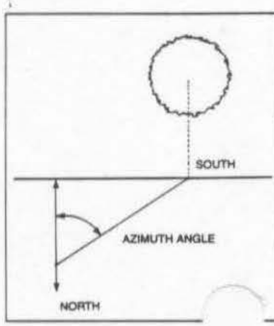


Ambient Temperature - The natural temperature surrounding an object; it usually refers to outdoor temperature.

Angle of Incidence - The angle at which direct sunlight strikes a surface. The angle of incidence affects the amount of energy absorbed by a solar collector. Sunlight with an incident angle close to 90° (perpendicular to the surface) tends to be absorbed, while lower angles tend to reflect light.

Auxiliary Heating -(see Backup Heating System)

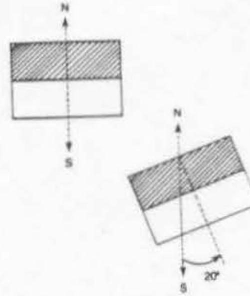
Azimuth (Solar) - One of two angles used to specify the sun's position at any given time; azimuth is the angle between south and the point on the horizon directly below the sun (Anderson, 1976). South is 0° and angles to the east and west are described as 0° to 180°E or 0° to 180°W.



Backup Heating System - A constantly available source of heat energy which is brought into operation when the solar system storage has been exhausted and the need for heat exists.

Bound Energy - The energy embodied in materials and goods during the complete raw material to manufactured product process including energy expended in transportation.

Building Orientation - The relationship of a building to south. A building's orientation is specified by the direction of its longest axis.



BTU or British Thermal Unit - The quantity of heat required to raise one pound of water one degree F.

Clerestory - Vertical window placed high in wall near eaves, used for light, heat-gain, and ventilation.

Collection - The act of trapping solar radiation and converting it to heat (also see Distribution and Storage).

Collector - Any device or area that uses the sun's energy to heat domestic water or to heat, cool, or light a living space. This broad definition includes not only familiar space and domestic water heating system collectors but also collectors for space cooling.

Collector Efficiency - The percentage of sunlight reaching the collector surface that can be extracted as useful energy.

Concentrating Collector - A collector with a lens or a reflector that concentrates the sun's rays on a relatively small absorber surface.

Convection - Heat transfer through a fluid (such as air or liquid) by currents resulting from the natural fall of heavier, cool fluid and rise of lighter, warm fluid.

Degree Day (DD) - The degree day is a unit of heat measurement equal to one degree variation from a standard temperature in average temperature of one day. If the standard is 65°F and the average outside temperature is 50°F for two days, then the number of degree days is 30.

Diffuse Sunlight - Sunlight that reaches the earth after being reflected off atmospheric particles. On a cloudy day, diffuse light may account for all the sunlight received at the surface. Diffuse sunlight comes along no set path; it generally comes from the entire skyvault, the most coming from the area of the sky near the sun.

Direct Solar Gain - A type of passive solar heating system in which solar radiation passes through the south-facing living space before being stored in the thermal mass for long term heating.

Distribution - The act of moving collected heat to needed areas. (Also see Collection and Storage.)

Double-walled Heat Exchanger - A heat exchanger which separates the collector fluid from the potable water by two surfaces; it is generally required if the collector fluid is nonpotable.

Drainback - A type of solar liquid heating system which is designed to drain into a tank when the pump is off.

Draindown - A type of liquid heating system which protects collectors from freezing by automatically draining when the pump is turned off.

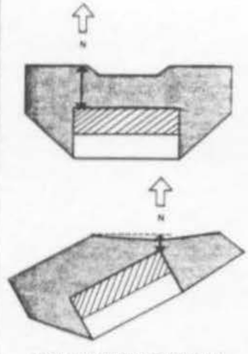
Earth Berms (or Berming) - A mound of earth either abutting a house wall to help stabilize temperature inside house, or positioned to deflect wind from house.

Easement - A form of private agreement with the potential to protect solar access. Easements are interests in property, which can be bought and sold like property itself. A common example is the utility easement.

Energy Audit	- An accounting of the forms of energy used during a designated period, such as monthly.
Eutectic salts	- A mixture of two or more pure materials which melts at a constant temperature; a material which stores large amounts of latent heat.
Energy Sharing	- Collecting solar energy on one building or portion of a building and distributing it to other areas which have poor solar access.
Evaporative Cooling	- Cooling provided by the evaporation of water. Evaporative cooling uses water's ability to absorb and store heat in the evaporative process, cooling itself and the environment in contact with it. This process is most effective during daytime hours; therefore most systems using this principle require integral shading devices.
Glazed Area (or Glazing)	- For solar collection, glazing refers to all materials which are translucent or transparent to short-wave radiation, including glass, plexiglass, Kalwall™, etc.
Greenhouse	- (See Chapter 5)
Heat Exchanger	- A device which tranfers heat from one fluid to another.
Heating Load	- The rate of heat flow required to maintain indoor comfort; measured in BTUs per hour.
Heat Pump	- An electrically operated machine for heating and cooling; when heating, it transfers heat from one medium at a lower temperature (called the heat source) to a medium at a higher temperature (called the heat sink), thereby cooling the source (outside air) and warming the sink (the house); when cooling, the heat pump functions much like an air conditioner - taking unwanted heat from the heat source (a building) and dumping it to the heat sink (the outside).
Heat Sink	- A massive body which can serve to absorb and store solar heat.
Hogged Wood Fuel	- The bark and chips residue from a sawmill operation; commonly used as a fuel.

Hybrid Solar Heating System	- Solar heating system that combines active and passive techniques.
Indirect Gain	- A type of passive solar heating system in which the storage is interposed between the collecting and the distributing surfaces (e.g., Trombe wall, water wall, or roof pond).
Infiltration	- The unwanted admittance of air through cracks and pores which increases heat transfer.
Internal Mass	- Massive materials with heat storage potential contained within the building as walls, floors, or freestanding elements.
Kilowatt	- A measure of power or heat flow rate; it equals 3,413 BTU per hour.
Kilowatt Hour (kWh)	- The amount of energy equivalent to one kilowatt of power being used for one hour.
Life Cycle Costing	- Analyzing the cost of an investment (for example, a building, a piece of equipment, or a vehicle) over its useful life, rather than simply viewing cost as purchase price; this LCC method provides a means of assessing the comparative operating energy costs of traditional and energy-efficient systems.
Microclimate	- The climate of a specific site or portion of a site. Microclimates result from the overall regional climate as it is affected by local site conditions, including ground slope and orientation, topographic features, elevation, vegetation, water bodies, ground surface, and buildings. These microclimatic influences affect both the heating and cooling requirements of houses and their potential for solar access.
Moveable Insulation	- Insulation placed over windows when needed to prevent heat loss or gain, and removed for light, view, venting, or heat.
Natural Cooling	- Space cooling alternatives to energy-consumptive central air-conditioning systems. The five principal means of natural cooling are: shading, ventilation, conduction control, radiation, and evaporation.

North Projection - The length of an object's shadow pattern measured along the north/south axis.



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Orientation - The position of an object with respect to true compass points. (See Building Orientation.)

Passive Solar Energy System - A system where the collector and thermal storage components are integrated, requiring no transfer device for solar-heated fluid. A passive system tends to have less hardware than an active system; it is usually built as an essential integral component of the building.

Passive Solar Energy Systems and Design - Passive solar heating applications generally involve energy collection through south-facing glazed areas; energy storage in the building mass or in special storage elements; energy distribution by natural means such as convection, conduction, or radiation with only minimal use of low-power fans or pumps; and a method controlling both high and low temperatures and energy flows. Passive cooling applications usually include methods of shading collector areas from exposure to the summer sun and provisions to induce ventilation to reduce internal temperatures and humidity.

Payback - The time needed to recover the investment in a solar energy system.

Phase-change - The change in heat content that occurs with a change in phase and without change in temperature; the heat stored in the material during melting or vaporization. Latent heat is recovered by freezing a liquid or by condensing a gas.

Peak Load	- The design heating and cooling load used in mechanical system sizing. Usually set to meet human comfort requirements 93%-97% of the time.
Photovoltaic Cell	- A device without any moving parts that converts light directly into electricity by the excitement of electrons.
Planned Unit Development (PUD)	- A development planned as a whole, where conventional subdivision regulations (such as type of housing, height limitations, setbacks, densities, and minimum lot sizes) are reconsidered to allow more design flexibility and amenities. This kind of development has greater potential for solar access planning than does conventional development.
Planned Solar Residential Development	- A residential development designed to make optimum use of solar energy for domestic hot water and space heating and which is located on a tract of land with suitable solar access and at densities which are consistent with the provisions of energy efficient patterns of development.
Plenum	- A cavity of air space through which air is moved. In some passive solar designs a plenum may be used to evenly distribute heat which otherwise would collect at a single point.
Restrictive Covenants	- The most common form of private agreement that can be used to protect solar access; a restrictive covenant is a contract between two or more people which involves mutual promises of reciprocal benefits and burdens among the contracting landowners.
Retrofit	- To add a solar heating or cooling system to an existing home, previously conventionally heated and/or cooled.
R-value	- Capability of a substance to impede the flow of heat. The term is used to describe insulative properties of construction materials. (Also see Thermal Resistance.)
Seasonal Efficiency	- The ratio of the solar energy collected and used to the solar energy striking the collector; measured over an entire heating season.

Solar Fraction - The percentage of a building's net heating load met by solar gain.

Solar Gain - The absorption of heat from the sun. The amount of solar radiation (BTU's) received on an identified surface.

Solar Skyspace - The space between a solar energy collector and the sun which must be free of significant obstructions to ensure the cost effective operation of the system between the hours of 9 a.m. and 3 p.m. on June 21st and December 21st of each year. Protecting solar access simply means locating objects, such as buildings and trees, where they will not shade a collector's skyspace. Skyspace is specified by used latitude-dependent skyspace angles, which give the sun's position at critical times. Skyspace requirements vary with latitude and the use pattern of the collector.

Stagnation - A high temperature condition obtained in a solar collector when the sun is shining and no fluid is flowing through the collector; temperatures range from 250°F to 400°F, depending on collector design. Any condition under which a collector is losing asmuch heat as it gains.

Solar Access - Allowing sunlight to strike a solar collector. This is accomplished by locating obstructions, such as buildings and trees, where their shadows will not fall on a collector during critical periods of operation. The concept of skyspace defines that portion of the sky which must remain unobstructed and defines specified critical angles for use in solar planning.

Solar Angles - Angles used to specify the sun's position at a given time. (See Altitude and Azimuth.)

Sun Tempered - A building whose long walls and major glazing surfaces are oriented to the south. This maximizes beneficial sunlight warming the building in winter. Overhangs or shading devices shade glazing to minimize unwanted heat gain in summer. Solar tempering can be used to advantage in almost all climates.

Surface-to-Volume Ratio	- The ratio of exposed surface of a building to occupied volume. A measure of exposure to harsh climate conditions causing unwanted heat loss and heat gain. (Lower numbers are desirable). This ratio is especially useful in evaluating alterna building forms.
Therm	- A quantity of heat equal to 100,000 BTU; approximately 100 cubic feet of natural gas.
Thermal Mass	- Any material used to store the sun's heat or the night's coolness. Water, concrete, and rock are common choices for thermal mass. In winter, thermal mass stores solar energy collected during the day and releases it during sunless periods (nights or cloudy days). In summer, thermal mass absorbs excess daytime heat and ventilation allows it to be discharged to the outdoors at night.
Thermal Resistance	- The ability of a substance to impede the flow of heat. (Also see R-value.)
Thermosiphon	- A method of circulating a fluid in which the warmer, less dense portion rises above the cooler. This method can be used in place of pumps to transfer solar-heated water or air.
Trombe Wall (or Solar Mass Wall)	- A wall that absorbs collected solar heat and holds it until it is needed to heat house interior.
U-value	- The rate of heat transmission measured per degree of temperature difference per hour, through a square foot of wall or other building surface.
Vapor Barrier	- A waterproof liner used to prevent passage of moisture through the building structure. Vapor barriers in walls and ceilings should be located on the heate side of the building.

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